PRACTICAL

ARITHMETICK

IN FOUR BOOKS,

I. Of Whole Numbers, Weights, and Measures.
II. Fractions Vulgar and Decimal.
III. Mercantile Arithmetick.
IV. Extractions, Progressions, Logarithms, &c.

EXTRACTED FROM THE LARGER ENTIRE

TREATISE,

CARRIED ON BY SUBSCRIPTION, AND ADAPTED TO

THE COMMERCE OF IRELAND,

AS WELL AS THAT OF GREAT BRITAIN.

FOR THE USE OF SCHOOLS.

BY JOHN GOUGH.

CAREFULLY REVISED, WITH MANY ADDITIONS IN THE VARIOUS RULES,

BY ROBERT TELFAIR, OF THE BELFAST ACADEMY.

TO WHICH IS ADDED,

AN APPENDIX OF ALGEBRA,

BY WILLIAM ATKINSON,

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PREFACE.

THE Reader is here presented with a Treatise of *Practical Arithmetick for the Use of* SCHOOLS, being a complete Extract of the Practical Part from my *Treatise of Arithmetick in Theory and Practice.*

The first Edition of which Work being now mostly disposed of, and having received some friendly Remonstrances as to the Execution of it, with Respect to Paper and Type, I resolved to publish a second Edition in an Elegant octavo Volume by Subscription; but as this proposed Edition might be thought too expensive for a common School Book, I (having by Experience in my Profession as well as by the growing Demand, found its usefulness as such) have thus published the Practical Part distinct, at a low price, which I apprehend will be thought sufficient for the common Use of School Boys, while the Work at large, will be highly useful to Masters for a Fund of Instruction, as well as to Students who are well accomplished in the Practical Part.

The Method was partly suggested by a Note on *Rollin*'s Thoughts concerning Education, p. 44, of the *Dublin* Edition, which appearing to contain some useful Hints, I transcribe at length, *viz.*

" Arithmetick might be taught in Schools, in a much
" more expeditious Way than it generally is, by dividing
" the Scholars into Forms, in the same Manner as in teach-
" ing Languages, the Whole may be divided into five, six
" or more Classes: Ten of the Pupils, for instance may
" be in Multiplication, Six in the Rule of Three, Thir-
" teen in Practice, and so on, Whenever any Class is to
" proceed to a new Rule, the Master may explain to them
" in Chalk on two large Boards, or some such Thing, the

" Nature and Genius of the Rules into which they are en-
" tering. A considerable Time should be employed in
" these Explications, and the Scholars might take Places,
" as in learning Latin, &c. which could not fail of inspi-
" ring them with great Emulation. The several Pupils in a
" Form should always be set the same Sum or Question,
" but must be separated to prevent their copying one from
" another. 'Twould also be proper to draw up for their
" Use, an Epitome of Arithmetick, by way of Question
" and Answer, containing the Nature and Explanation of
" the several Rules in that Science, this they should copy,
" and learn by heart perfectly; by which Means they
" would be able, not only to state their several Questions
" very expeditiously, but to give a Reason for every Thing."

I apprehend the usual Method of Teaching Arithmetick is two-fold, either the Master or Assistant writes down the Rules and Qustions for the Boys, or causeth them to write them themselves from printed Books or Manuscripts: The former Method is much more toilsome to the Teacher, and besides takes up much Time, which I presume might be better employed in instructing the pupils, and explaining to them the Nature of their Rules. And as most of the printed Books are intended to explain the Doctrine of Arithmetick in general to those who may want to improve themseves by reading, the Questions are most or at least too many of them wrought, for which Reason they are not suitable to be laid before the Boys, as they would make no scruple of copying the Work of their Author to ease themselves of the Trouble of performing it; besides as the Number of these in a School is generally few, it occasions Perplexity and Delay, while one waits for another to copy out his Rule or Question; the same Objection lies against one general Manuscript, altho' it consists of Questions and their Answers only.

To avoid this inconvenience, some Teachers have disposed the several Rules of Arithmetick, with proper Questions and their Answers, into little Manuscripts of a Sheet or two of Paper, orderly numbered; But these wearing out with continual Use, it occasions very considerable Labour to keep a School properly supplied therewith; from which Considerations, the Utility of introducing such a Book as this

this (properly drawn up) into our Schools, will be ſeen at the firſt View.

Although Regularity of Method ſeemed to point out the Order, or Plan I have obſerved; yet I am not of Opinion it will be neceſſary to teach all the Parts in Order as they lie; I think it will be beſt to begin with Whole Numbers, and proceed thro' Notation, Addition, Subtraction, Multiplication and Diviſion: Addition and Subtraction of Numbers of divers Denominations, Reduction and the Rule of Three to the Contractions, without meddling with the Queſtions at the End of the Rules: This may be a firſt Courſe. *2dly*, Suppoſe they go over the ſame with the Queſtions, and Multiplication and Diviſion of Numbers of divers Denominations; thro' the Rule of Three entirely, and then proceed thro' Fractions, Vulgar and Decimal. *3dly*, Begin again at Multiplication of divers Denominations, and ſo proceed orderly quite thro' Mercantile Arithmetick, and in theſe Reviews the Learners may be detained a longer or ſhorter Time in any Rule, as they may appear more or leſs ready in the Calculation thereof: *4thly*, And if again they went thro' the whole with the Reaſons of the Rules, I do not apprehend ſuch a Method abſurd: or ſuch a Reviſal of the ſame Rules unneceſſarily tedious: But I only mean juſt to hint my Apprehenſion of the uſe to be made of ſuch a Book, without pretending to preſcribe to Teachers, many of whom, without Doubt, are men of much more Experience than myſelf, and of greater Abilities likewiſe.

If any of theſe find any material imperfections in this Work, have any Amendments to propoſe, or any Improvements of the Plan, if they will be ſo kind as to impart them to the Author, he hopes to receive them with Candour, give them the due Deference, and to make the neceſſary uſe of them (with a ſuitable Acknowledgment) in a future Edition of the Work, if there ſhould be hereafter Occaſion for it.

JOHN GOUGH.

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BOOK I.

OF WHOLE NUMBERS.

N. B. The Rules marked thus † are those added by Mr. TELFAIR.

BOOK II.

OF FRACTIONS.

BOOK

BOOK III.

MERCANTILE ARITHMETICK.

BOOK IV.

EXTRACTIONS OF ROOTS.

EXPLANATION

OF CERTAIN CHARACTERS USED IN THE FOLLOWING WORK.

$+$ PLUS, or more, is the Mark of Addition; and denotes the Numbers it ſtands between are to be added together.

$-$ Signifies *Minus*, or leſs, is the Sign of Subtraction; and when it ſtands between two Numbers, it denotes that the latter is to be taken from the former.

$\times$ Is the Mark of Multiplication; and denotes that the Numbers betwixt which it ſtands are to be multiplied.

$\div$ Is the Mark of Diviſion: and, when two Numbers are placed in the ſame Manner as the Points are here, it denotes, that the Number above the Line is to be divided by that below.

$=$ Is the Mark of Equality; which being ſet between two numerical Expreſſions, denotes they are equal between themſelves.

: : : : Are Marks of proportionality; and denote that the Numbers betwixt which they are placed, are proportional Numbers.

Example.

For $4+3=7$; read 4 more 3 is equal to 7.

For $4-3=1$; read when 3 is taken from 4 the Remainder is equal to 1.

For $4\times3=12$; read 4 multiplied by 3 produces 12.

For $\frac{12}{3}=4$; read 12 being divided by 3, the Quotient is equal to 4.

For : 4: : 3 : 12; read, as 1 is to 4, ſo is 3 to 12.

N. B. The *Additional Problems*, to the various Rules of this Work, are *thus* † *marked*, and diſtinguiſhed by a *ſhort Daſh thus* :———at the Begining and Ending of each.

A

TREATISE

OF

ARITHMETICK.

BOOK I.

ARITHMETICK is that Part of Mathematicks, which exhibits the Doctrine of *NUMBERS* explains their Properties; and teaches the Art of calculating them.

CHAP. I.

NOTATION OF NUMBERS.

Notation is the writing of Numbers properly.

1. All Numbers are expressed by the different Disposition of the following ten Characters, called Figures:

Cypher or Nought	One	Two	Three	Four	Five	Six	Seven	Eight	Nine
0	1	2	3	4	5	6	7	8	9

2. The Value of these Figures appears above at the first View; but we must observe, that besides their simple Value, there expressed, they receive a new value from the Place they possess in Numbers expressed by several Figures.

3. The Value of the Places encreases in a tenfold Proportion infinite.

4. The first Place is that next the Right hand; the second the next on the Left of it, and so on.

5. Every Figure ſtanding alone expreſſes its own Value, as 7 expreſſes the Number Seven, 9 Nine, *&c.*

6. If a Number be expreſſed by more Figures than one, (as every Number above Nine is) then the firſt Figure ſignifies its own Value or Units, the ſecond ten Times its own Value, or as many Tens as ſingly it expreſſes Units, *&c.* Thus in the following Numbers:

17 Seventeen
71 Seventy one
64 Sixty-four

The firſt Figures 7, 1, 4, ſignify ſimply their own Value, *viz.* 7 Seven, 1 One, and 4 Four; but the ſecond Figures 1, 7, 6, receive a new Value from their Place, and ſtand for ten Times their ſimple Value, *viz.* 1 ſignifies Ten, 7 Seventy (ſeven Tens) and 6 Sixty (or 6 Tens.)

7. In like manner, a Figure in the 3d Place ſignifies ten Times ten Times, or a hundred Times as much as it would in the firſt, as in the Numbers:

317 Three Hundred and Seventeen
571 Five Hundred and Seventy-one
764 Seven Hnndred and Sixty-four

And ſo continually every Figure to the Left-Hand has ten Times the Value it would have in the next Place to the Right, and ſignifies ten Times its own Value, ſo often repeated as its Place is diſtant from the firſt or Units Place.

8. Whence it follows, and is eaſy to be conceived, that every Ten of the Value of a lower Place is equal to 1 of the next higher.

9. But as the frequent Repetition of Tens would occaſion obſcurity and confuſion, different Terms are uſed to expreſs the local Value of Figures, as by the following:

Table I.

Table I.

	Place	Name
First Period	First	Units
	Second	Ten ——X
	Third	Hundreds —C
	Fourth	Thouſands—M
	Fifth	X of Thouſands
	Sixth	C of Thouſands
Scond Period	Seventh	Millions
	Eighth	X Millions
	Ninth	Hundreds of Millions
	Tenth	Thouſands of Millions
	Eleventh	X of Thouſands of Millions
	Twelfth	C of Thouſands of Millions
Third Period	Thirteenth	Millions of Millions, or Billions
	Fourteenth	X of Billions
	Fifteenth	C of Billions
	Sixteenth	Thouſands of Billions
	Seventeenth	X Thouſands of Billions
	Eighteenth	C of Thouſands of Billions
	Nineteenth	Millions of Billions, or Trillions.

10. Under every ſixth Place we draw a Line of Separation for this Reaſon; becauſe the next Place (according to the preceding Progreſſion of the Places) would be Thouſands of Thouſands; but again to prevent the Obſcurity that the frequent Repetition of the ſame Word would occaſion, we uſe the Term Millions to ſtand for a Thouſand Thouſand, and then proceed to name the next 5 Places ſucceſſively, by prefixing to the Word Millions the ſame Terms, in Order as in the 5 Places after Units; and ſo on in a continual Rotation; every round of ſix Places is named a Period, and the Table may be yet continued further at Pleaſure, by learning Names for the loweſt Place of each ſucceeding Period, as in the following:

Table II.

Of the loweſt Place of the		Period, the Name is
	Firſt	Units
	Second	Millions
	Third	Billions
	Fourth	Trillions
	Fifth	Quadrillions
	Sixth	Quintillions
	Seventh	Sextillions
	Eighth	Septillions
	Ninth	Octillions, &c.

11. Likewiſe each Period may be ſub-divided into two equal Parts, which may be called Members, conſiſting of three Places each.

Of the Cypher.

12. The Cypher by itſelf ſignifieth nothing, and put to the Left-Hand of another Figure, altereth not its Value, thus 7, 07, 007, all expreſs the Number ſeven, and no more, ſince the ſignificant Figure 7 is ſtill in Units Place.

13. But a Cypher being put to the Right-Hand of a Figure, encreaſes its Value ten Times, becauſe it removes it to the ſecond Place, and two Cyphers, in like Manner put, encreaſe a Figure's Value an hundred Times, by raiſing it to the third Place, and ſo on, as,

7 Seven
70 Seventy
700 Seven Hundred
7000 Seven Thouſand

14. Likewiſe a Cypher to the Left-Hand of any Number altereth not its Value, ſince every ſignificant Figure continueth to poſſeſs the ſame Place, as,

45
045
0045, &c.

15. But if a Cypher be put to the Right-Hand of any Number,

Number, it encreaseth its Value ten Times, by removing every Figure one Place higher, two Cyphers in like Manner situate, 'cause that the significant Figures express a Number a hundred times as much as without the Cyphers, since every Figure is removed two Places higher by such Appositions of the Cyphers, as,

45 Forty five
450 Four Hundred and Fifty
4500, *&c.* Four Thousand five Hundred

ROMAN NOTATION.

The Characters used by the *Romans* to express Numbers were the following, *viz.*

I. One. V. Five. X. Ten. L. Fifty.

C. one Hundred. D. five Hundred. M. one Thousand.

I.	One	X.	Ten	C.	one Hundred
II.	Two	XX.	Twenty	CC.	two Hundred
III.	Three	XXX.	Thirty	CCC.	three Hundred
VI.	Six	LX.	Sixty	DC.	six Hundred
VII.	Seven	LXX.	Seventy	DCC.	seven Hundred
VIII.	Eight	LXXX.	Eighty	DCCC.	eight Hundred
IV.	Four	XL.	Forty	CD.	four Hundred
IX.	Nine	XC.	Ninety	XM.	nine Hundred.

QUESTIONS

AND

PRACTICAL EXAMPLES

ON THE FIRST CHAPTER.

Quest. WHAT is Arithmetick? *Answer*, The Art of managing or calculating Numbers.

Q. What is Notation?

A. The writing Numbers properly.

Q. How are Numbers written or expressed?

A. All Numbers are expressed by the different Disposition of the following Characters:

Nought	One	Two	Three	Four	Five	Six	Seven	Eight	Nine
0	1	2	3	4	5	6	7	8	9

Q. How can all Numbers be expressed by these Characters?

A. By the APPLICATION of the

NUMERATION TABLE.

C Millions, &c.	X Millions	Millions	C Thousands	X Thousands	Thousands	Hundreds	Tens	Units
9	8	7	6	5	4	3	2	1

Q. What have we observed of the Cypher, or 0?

A. That by itself it signifies nothing; being put on the

Left-hand of any Number it altereth not its Value; but being put to the Right-hand, every Cypher maketh the Number ten Times what it was before.

Examples *for Practice.*

Write down in Figures.

1. Seventeen, *Answer*, 17.
2. Eleven —— ——
3. Fourteen —— ——
4. Thirty-six —— ——
5. Ninety-one —— ——
6. One hundred and fifty-four —— —— 154
7. Two hundred and eighty-seven —— ——
8. Six hundred and twelve —— ——
9. One hundred and Fourteen —— ——
10. Five hundred and four —— —— 504
11. Nine hundred and nine —— ——
12. Seven hundred and sixty —— ——
13. Six hundred and ten —— ——

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14. One thousand four hundred and twenty-five, *Answer*, 1425
15. Three thousand six hundred and forty-four ——
16. Two thousand nine hundred and eleven ——
17. Six thousand and eighty-four —— ——
18. Six thousand eight hundred and four —— ——
19. Six thousand eight hundred and forty —— ——
20. Seven thousand and six —— —— ——
21. Seven thousand and sixty —— —— ——
22. Seven thousand six hundred —— —— ——
23. Four thousand —— —— —— ——
24. Eight thousand —— —— —— ——

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25. Seventy eight thousand six hundred and forty-eight —— —— 78648
26. Ninety-one thousand three hundred and fifty-seven —— ——
27. Forty thousand four hundred and fifty ——
28. Eighty thousand and eighty —— ——
29. Ninety thousand and nine —— —— ——
30. Fifty thousand —— —— —— ——

31. One hundred and twenty-ſeven thouſand three hundred and ninety four — — } 127394
32. Four hundred and fifty ſix thouſand ſeven hundred and eighty nine —— —— }
33. Six hundred two thouſand four hundred and nine —— —— —— }
34. Five hundred and forty thouſand eight hundred and five —— —— }
35. Eight hundred thouſand and eight ——
36. Three hundred thouſand — ——
37. Nine hundred thouſand five hundred ——

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38. Three millions one hundred and twenty ſeven thouſand three hundred and ninety-four } 3127394
39 Four millions four hundred and fifty-ſix thouſand ſeven hundred and eighty nine }
40. Eighty millions forty thouſand and ſixty —
41. Seven millions four hundred thouſand ——
42. Nine millions —— ——

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43. What is 7 in the third Place, and how expreſſed?
44. What is 9 in the fifth Place?
45. What is 5 in the ſecond Place?
46. What is 8 in the fourth Place?
47. What is 6 in the ſixth Place?
48. What is three in the ſeventh Place?

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§ NUMERATION,

Is the right reading or reciting a Number expreſſed by Figures.

Rule. I.

1. To read any Number not exceeding three Figures, conſider the Value each Figure receives from its Place, and read each with the Name of its Place adjoined thus, read three in the ſecond Place, thirty; in the third Place, three hundred; and ſeven in the ſecond, ſeventy; in the third, ſeven hundred, &c.

Hundreds

Hundreds	Tens	Units	Hundreds	Tens	Units	Hundreds	Tens	Units
	1	7	8	6	4	0	2	5
	7	5	4	6	0	6	3	7
	4	6	4	0	6	9	0	0
	9	0	5	2	0	9	9	9
3	2	7	5	0	2	8	6	0

Rule II.

2. To read a Number not exceeding ſix Figures, or a * Period

Separate by a Comma, the firſt Member from the other Figures, then read the ſecond ‡ Member, or a Part of it, juſt as the firſt, or a Part thereof: only call the ſecond Member thouſands.

Examples.

Thouſand	Thouſand	Thouſand
5,423	74,370	753,753
2,735	93,058	407,047
3,025	60,108	370,000
2,400	30,000	507,208
9,003	90,008	530,003
		300,000

Rule III.

3. To read a Number conſiſting of any Number of Figures whatſoever.

Divide it into Periods by prefixing a Point to every ſixth Figure; then read every Period alike, ſubjoining to each the Name of the Place of its loweſt Figure, which may be known from the ſecond Table preceding.

* A Period is every 6 Figures in any Number taken from Units.

‡ A Member is half a Period, or 3 Figures from Units.

Example.

	470 .	368423 .	078642
	98073 .	540087 .	248000
	476308 .	753246 .	538240
7532 .	400653 .	240865 .	429086
53784 .	279085 .	420006 .	278053
123456 .	789012 .	345668 .	901234
Trillions	Billions	Millions	Units

CHAP II.

ADDITION.

20. ADDITION is the joining or collecting ſeveral Numbers into one, or finding a Number which ſhall be equal to any given Numbers altogether.

GENERAL RULE.

Let the Numbers marked A B C, be given to be added.

1. Place the Numbers ſo that each Figure may ſtand directly underneath (or in the ſame perpendicular Row with) the Figures of the ſame Value, that is: Units under Units, Tens under Tens, Hundreds under Hundreds, &c.

54327	A
8062	B
5041	C
67430	

Then drawing a Line under them; begin the Addition at the firſt Place (or Units) and add together all the Figures in that Place, and if their Sum be under Ten, ſet it down below the Line underneath its own Place; but if their Sum be more than Ten, ſet down only the Overplus above the Ten (or Tens) and ſo many Tens as the Sum of theſe Units amount to, carry to the Place of Tens, adding them and the Figures which ſtand in the Place of Tens together; then proceed in the ſame Manner to the third Place, or Hundreds, and ſo from Place to Place to the laſt, and ſet down the whole Sum of the laſt Place.

Application.

Application.

The Marginal Numbers being placed as before directed, I add together the first Figures 1 and 2 [3] and 7 [10], and find their Sum to be 10, I set down [0] the Overplus above Ten, and for the Ten I add 1 with the Figures of the next Place, *viz.* 1 and 4 [5] and 6 [11] and 2 [13]. Again, I set 3 the Overplus above Ten, and add 1 for the (one) Ten to the Figures in the next Place, *viz.* 1 and 3 is 4, which being under Ten I set it down in the same Place, and proceed in like Manner to the last Place, and the Work is done.

```
 54327
  8062
  5041
 -----
 67430
```

† TABLE OF ADDITION.

To be committed to Memory by the Learner, previous to his entering into the Rule.

0	1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9	10
2	3	4	5	6	7	8	9	10	11
3	4	5	6	7	8	9	10	11	12
4	5	6	7	8	9	10	11	12	13
5	6	7	8	9	10	11	12	13	14
6	7	8	9	10	11	12	13	14	15
7	8	9	10	11	12	13	14	15	16
8	9	10	11	12	13	14	15	16	17
9	10	11	12	13	14	15	16	17	18

The Manner of using the Table is thus: take the greater of the two Figures, whose Sum is sought in the upper Line, and the lesser in the Left hand Column in the same Line with this, and underneath the other stands the Sum. As suppose I wanted the Sum of 9 and 7, then I look for 9 on the Head of the Table, and in the same Line with 7 on the Side stands 16, the Sum.

Rule II. *Example* II.

When the Numbers to be added are many, the following Method may be practised: Begin with the lowest Figure of Units Place (as before) and joining it to the Figures above it (as *per* last Rule) for every Ten arising in the Addition, make a Point over against the Figure which added to the former maketh Ten or more than Ten, add the Overplus above Ten to the next Figure above it, and so proceed to the Top; then count the Points

```
 74·36
 2179·
 5087·
 685·3
 2404·
 7287
 -----
 31306
```

and

and how many they are, so many carry and add to the Figures of the next Place, and proceed in like Manner thro' all the Places, and the Points of the last Place collect, and set their Number to the Left hand of the Figure under the last Place.

This Rule doth not differ essentially from the last, being only a Contrivance to help the Memory.

Rule III.

To prove Addition.

Begin the Addition at the uppermost Figure at the highest Place, *viz.* next the Left-hand, and add downward and place the lowest Figure of the Sum directly under the added Figures, and the other Figures of the Sum on the Left-hand of it: Then begin with the uppermost Figure of the next lower Place, and add downwards in like Manner, and still place the lowest Figure of the Sum under the added Figures as before (29); so we shall get as many Sums as the Numbers (or greatest Number) have Places, and each one place nearer the Right-hand: Let those Sums be added together (*per* Rule 2.) and if their Sums agree with the Sum of the given Numbers before found, the Work may be presumed to be truly done.

```
 7436
 2179
 5087
 6853
 2464
 7287
 ----
 29
  19
   37
    36
 -----
 31306
```

Questions *and practical* Examples.

Q. How are Numbers to be placed, in order to be added?

A. Units under Units, Tens under Tens, *&c.*

Q. How are Numbers to be added?

A. Begin at Units Place, and add the lowest Figure in that Place to that above it; then add their Sums to the next Figure in the same Place, and so on to the Top: set down the Overplus above Ten or Tens, and for every Ten carry one to the next Place, *&c.*

(1)	(2)	(3)	(4)
236	2486	3946	4675
643	3255	7932	7998
457	7667	8363	3997

(5)	(6)	(7)	(8)
245	6804	1524	2000
956	9120	7361	4798
201	9000	2000	2547
904	7660	5859	5000
			9568

[9] 9568	[10] 9658	[11] 4268	[12] 2823
5732	5973	2646	9208
9601	1579	3500	6524
2367	6137	6482	1282
8524	9795	8264	2627
5378	1793	6828	8344

[13] 576894	[14] 9768939	[15] 9864830	[16] 87698767
79865	8970695	572970	69789763
93784	9179642	3795	96827527
6798	9756879	43962	54328106
3297	3019431	869874	33708327
986	2137540	38237	90109461
4696	5967389	784	84176875
4796	4679849	77963	57867148
3210	4839518	6475	38210739
7826	8763649	328	93701283
5037	2198754	987	51068027
78989	9763475	[illegible]63974	72086015

QUESTIONS.

1. A Merchant on ſettling his Accounts, finds he owes *A* 60*l.* *B* 156*l.* *C.* *D* 264*l.* and *E* 27*l.* I demand how much he owes in all? *Anſwer*, 507*l.*

2. A Merchant ſends his Clerk with the following Bills for Payment, *viz.* one on *I. J.* for 60*l.* one on *A. B.* for 84*l.* one on *C. D.* for 167*l.* one on *D. S.* for 125*l.* and one on *E. F.* for 500*l.* I want to know the Sum he received in all? *Anſwer*, 936*l.*

3. Bought 8 Caſks of Indigo, No. 1, 210lb; No. 2, 196lb; No. 3, 4, 5, 205lb each; No. 6, 184lb; No 7, 225lb; and No. 8, 174lb. How many Pounds did the whole 8 Caſks contain? *Anſwer*, 1604lb.

A Linen-Draper bought 10 Bales of Linen-Cloth, containing as follows, *viz.* No. 1, 2, 367 Yards each; No. 3, 4, 5, each 407 Yards; No. 6, 7, 8, each 288 Yards; No. 9, 10, each 300 Yards. I deſire to know how many Yards he bought in all? *Anſwer*, 3419.

5. A certain Man being aſked his Age, anſwered, I have 7 Sons, and between the Birth of each was two Years, at the

the Age of 21 I had my eldeſt Son, which is now the Age of my youngeſt; it is required to tell his Age?

Anſwer, 54 Years old.

6. A Vintner buys 6 Pipes of Brandy, containing 120 Gallons, 118, 125, 121, 127 and 119. How many Gallons did he buy in all? *Anſwer*, 730.

7. How many Days in the whole Year*?

8. If from the Creation to the flood was 1650 Years; from the flood to the Vocation of *Abraham* 427; from the Vocation of *Abraham* to the founding of the Temple 1010; from that to the Foundation of *Rome* 266; thence to the Birth of Chriſt 752; and ſince that 1767 Years; how long is it ſince the Creation? *Anſwer*, 5872 Years.

9. How many Strokes doth a regular Clock ſtrike in a Week? *Anſwer*, 1092.

10. The leſſer of the two Numbers is 276, the Difference between them 96: How much is the greater? *Anſw.* 372.

11. What Day of the Year was the 27th of the 8th Month, *Auguſt*, 1765? *Anſwer*, 239th.

12. What Day of the Year was 21ſt of the 6th Month, *June*, 1764? *Anſwer*, 173d.

13. If from *Dublin* to *Naas* be 14 Miles; from *Naas* to *Caſtledermot* 19; from thence to *Carlow* 5; from *Carlow* to *Kilkenny* 18; thence to *Clonmel* 24; thence to *Kilworth* 23; and from *Kilworth* to *Corke* 18; How many Miles then is it from *Dublin* to *Corke*? *Anſwer*, 121 Miles.

14. Suppoſe the Diſtance from *Dublin* to *Holyhead* is 60 Miles; from *Holyhead* to *Cheſter* 87; from *Cheſter* to *Whitchurch* 20; from *Whitchurch* to *Newport* 20; from thence to *Iveſſey-Bank* 9; from thence to *Meredon* 34; from *Meredon* to *Coventry* 6; thence to *Daventry* 20; thence to *Towceſter* 12; thence to *Stoney-Stratford* 8; from *Stoney-*

* *N. B.* The Number of Days in the ſeveral Months in the Year by ſome Authors, are comprized in the following Lines:

Thirty Days are in *September*,
In *April*, *June*, and in *November*;
February hath twenty eight alone,
And all the reſt have thirty-one.
Now ſum them up and let us hear
How many Days in all the Year. *Anſw.* 365.

Stratford

Stratford to *Dunstable* 18; thence to *St. Albans* 13; and thence to *London* 21; How many Miles is it from *Dublin* to *London?* *Answer.* 328 Miles.

† 15. Find how many Years it was from the Creation of Adam to the universal Deluge; by the 5th Chapter and 6th Verse of the 7th Chapter of Genesis. *Ans.* 1656 Years.

CHAP. III.

SUBTRACTION.

SUBTRACTION is the taking a lesser Number from a greater, and thereby finding the Remainder or Difference between them.

To prove Subtraction.

Rule.

Add the Remainder to the lesser given Number, and if the Sum come the same with the greater given Number, the Work is right.

† TABLE OF *SUBTRACTION.*

0	1	2	3	4	5	6	7	8	9
1	0	1	2	3	4	5	6	7	8
2	-	0	1	2	3	4	5	6	7
3	-	-	0	1	2	3	4	5	6
4	-	-	-	0	1	2	3	4	5
5	-	-	-	-	0	1	2	3	4
6	-	-	-	-	-	0	1	2	3
7	-	-	-	-	-	-	0	1	2
8	-	-	-	-	-	-	-	0	1
9	-	-	-	-	-	-	-	-	0

The Manner of using this Table is the same with that of Addition, only instead of adding the Figures together, subtract them.

QUESTIONS AND PRACTICAL EXAMPLES.

Q. What is *Subtraction?*
A. *Subtraction* from a Greater takes a less,
And thereby shews the Difference or Excess.
Q. How are the Numbers to be placed?
A. The Less beneath the Greater we dispose,
Units and Tens in correspondent Rows.
Q. How is *Subtraction* performed?
A. Take Ones from Ones, and Tens by Tens decrease,
If still the Figures to subtract are less;

But

But the lower Figure's greater, then
The lower Figure we deduct from Ten,
To what remains the upper Figure add,
The just Remainder of that Place is had;
To the next lower Figure carry One,
And thus from Place to Place the Work is done.

	[1]	[2]	[3]	[4]
From	8103	1969	1917	1540
Take	4193	1408	1718	1460

	[5]	[6]	[7]
From	6119889	4090987	6278500
Take	3599907	1989849	1435045

	[8]	[9]
From	69740167423	78000930402
Take	23420891075	53298495299

QUESTIONS.

1. A Vintner bought 20 Pipes of Brandy, containing 2459 Gallons, and sells 14 Pipes containing 1680 Gallons. How many Pipes and Gallons has he unsold?
Answ. 6 Pipes, containing 779 Gallons.

2. A Merchant bought 564 tanned Hides, weighing 16800lb; sells thereof 260 Hides, Weight 7809lb. How many Hides has he unsold and what do they weigh?
Answer, 304 Hides, containing 8991lb.

3. Suppose *Corke*, *Clonmell* and *Dublin*, lie in a straight Line, and the Distance between *Corke* and *Dublin* is 121 Miles, and from *Corke* to *Clonmel* is 41 Miles. I demand the distance between *Clonmel* and *Dublin*? *Ans.* 80 Miles.

4. How long is it since the happy Revolution which happened in the Year 1688, we are now in the Year 1786?
Answer, 98 Years.

5. What five different Numbers make 100?

6. What Number is that which being added to 977, the Sum will be 2081? *Answer*, 1104.

7. What Number must I subtract from 2081 that the Remainder may be 1104? *Answer*, 977.

8. If a Merchant owed 1000*l.* and hath paid in Cash 280*l.* and hath likewise given an Assignment on *Jacob Payer* for 156*l.* How much doth he still owe? *Answer*, 564*l.*

9. Bought

9. Bought 2000 Yards of Linen for 466*l.* and sold 1476 Yards for 369*l.* How many Yards have I left, and what do I want to make up the first Cost? *Answ.* I have 524 Yards, and want 97*l.*

10. What difference is there between the Age of *A*, born in the Year of 1693, and *B* that will be born 13 Years hence: the Question being put *Anno* 1773? *Answ.* 93 Years.

11. If I was born in the Year 1721, how many Years old am I this Year 1773? *Answer*, 52 Years.

12. If I am 42 Years old in 1773, what Year was I born in? *Answer*, 1731.

13. If a Lease bears Date 1st of the 1st Month 1722, how many Years are unexpired thereof, suppose it granted for 99 Years? *Answer*, 53 Years in 1768.

14. In four Bags were different species of Coin to the Value of 500*l.* in the first was 96*l.* in the second 120*l.* in the third 55*l.* I desire to know what Sum the fourth contained? *Answer*, 229*l.*

15. A Grant was made by the Crown, *Anno* 1239, which was forfeited 137 Years before the Revolution in 1688: How long did it continue? *Answer*, 312 Years.

16. Five notable Discoveries were made in 215 Years Time, *viz.* 1. The Invention of the Compass. 2. Gunpowder. 3. Printing. 4. *America.* 5. The Reformation. The last was brought about *Anno* 1517: The third 77 Years before: The second 42 Years after the first, and the fourth 148 Years after the second. The Question is, In what Year did each happen? *Answer*, Compass in 1302; Gunpowder 1344; Printing 1440; *America* 1492.

17. Thirty-three Years before the Restoration in 1660, the Crown granted Demesnes to certain Uses for 210 Years to come. The Proprietor in 1715 procured a Reversionary Grant for 99 Years, to commence after the Expiration of the first. In what Year will the second Term end?

Answer, *Anno* 1936.

† 18. A Snail in getting up a May-pole, only 20 Feet high, was observed to climb eight Feet every Day; but every Night it came down again four feet. In what Time, by this Method, did he reach the Top of the Pole?

Answer, the Night of the fourth Day.

† 19. The Semi diameter of the Earth's Orbit, or annual Path round the Sun, is about 81,000,000 of Miles, that of Venus 59,000,000; when they are both on the same Side of the Sun, they are in Perigœo; when on different

ferent Sides, in Apogæo: What is the Difference of their Distances in both these Positions?

Answer, 118,000,000 Miles.

† 20. If the mean Distance between the Earth and Sun be 81 Millions of Miles, and between the Earth and Moon 240 Thousand, how far are these two Luminaries asunder in an Eclipse of the Sun, when the Moon is lineally between the Earth and Sun? And in another of the Moon, when the Earth is in a Line between her and him?

Answer, { In an Eclipse of the Sun, 80,760,000 Miles.
In an Eclipse of the Moon, 81,240,000 Miles.

CHAP. IV.

MULTIPLICATION.

1. A Number is said to multiply a Number, when a Number is produced which contains the multiplied Number, as often as the multiplying Number contains Unity.

2. The multiplied Number is called the *Multiplicand.*

3. The multiplying Number, the *Multiplier.*

4. And the Number produced, the *Product.*

THE TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	10	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	90	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

Rule.

Multiply the firſt Figure of the Multiplicand by the given Multiplier, if the Product be leſs than Ten, ſet it down in the ſame place with the Multiplied Figure ; but if the Product be above Ten (or Tens) ſet down the Overplus only, and reſerve the Ten or Tens (in mind) then by the ſame Multiplier multiply the next figure of the Multiplicand, and to the Product add the Ten or Tens reſerved, and proceed in the very ſame Manner, until all the Figures of the Multiplicand are multiplied.

† *Example.*

(1) 256745
2
513490

(2) 785403
3

(3) 27540098
4

† (4) 349621
5

(5) 909704
6

(6) 47109879
7

† (7) 174675093
8

(8) 410097134
9

Caſe II.

When the Multiplier conſiſts of ſeveral Figures.

Rule.

1. Multiply the Multiplicand by the firſt or Units Figure of the Multiplier, and ſubſcribe the Product (as *per* laſt); in like Manner multiply by the ſecond Figure of the Multiplier, and ſo ſucceſſively by every Figure one by one, whereby there will be as many Products as there are ſignificant Figures in the Multiplier.

2. Place theſe Products in Order under one another, ſo that the firſt Figure ſtand directly underneath, or in the ſame Place with, the Multiplying Figures ; that is, the firſt Figure of the ſecond Product muſt ſtand under the ſecond Figure of the firſt Product, the firſt Figure of the third, under the ſecond Figure of the ſecond, and the third Figure of the firſt, &c.

3. Add all theſe Products together, and their Sum is the Product ſought.

Examples.

Examples.

```
   3042            (10) 7534628        (11) 37420768
    517                      25                  349
  -----            ------------        -------------
  21294 First Prod. by 7
  3042. Second Prod. by 10
 15210.. Third Prod. by 500
-------
1572714 Sum of the 3 Products.
```

```
(12) 5307652              (13) 7537209
         154                       387
```

```
(14) 42372432             (15) 24372048
         7438                      6323
```

```
(16) 753072468            (17) 93724376072
         57348                      471398
```

```
(18) 687654327            (19) 739425378395
     123456789                    47325612
```

Case III.

When the Multiplier hath Cyphers intermixed with the ſignificant Figures.

Rule.

1. Multiply firſt by the firſt ſignificant Figure, and by every other ſucceſſively, (omitting the Cyphers) ſo that there will be as many particular Products as ſignificant Figures in the Multiplier.

2. As before, Let the firſt Figure of every particular Product be put in the ſame Place with the multiplying Figure.

3. Add theſe Products together, &c. as in the laſt.

Examples.

```
(20) 570684               (21) 8504593
        304                        709
```

968347

(22) 968347	(23) 9735083
506	7006

(24) 74086572	(25) 63230875
50402	58007

(26) 504030201	(27) 750037298
102030405	6003005

(28) 47500340076354
4000753009

Case IV.

When the Multiplicand, or Multiplier, or both have Cyphers in the lowest Places.

Multiply by the other Figures, as before taught, neglecting the Cyphers till the Product be found; and then put all the Cyphers, both at the end of the Multiplicand and Multiplier, to the Right-hand of the Product.

(29) 75360	[30] 5048600
7200	307200

(31) 7325060	(32) 7630400
780200	7000

† *Case* V.

† When the Multiplier is such a Number that any two Figures, in the Table, being multiplied together, will produce it.

Rule.

† Multiply the given Number by one of these Figures, and that product by the other, which will give the desired Product.

Examples.

† *Examples.*

33. 346734 by 18	34. 129746983 by 32
35. 371496 by 64	36. 4070403204 by 96
37. 413721 by 132	38. 48149194 by 144

Multiplication was ſhewn to be a compendious Method of adding a Number to itſelf a determinate Number of Times, and from this Conſideration the Univerſal *Multiplication Table* was conſtructed: In like Manner we may conſtruct a Table of any Multiplicand whatever, *i. e.* find the Product thereof by each of the ſingle Figures by *Addition* only, and this Method is very uſeful in Caſe of large Multipliers.

Let the given Multiplicand be the Number 987654321

Conſtruction.

1	987654321
2	1975308642
3	2962962963
4	3950617284
5	4938271606
6	5925925926
7	6913580247
8	7901234568
9	8888888889
10	9876543210

Add the given Multiplicand to itſelf, then we have the Product thereof, multiplied by 2. Again, add the ſaid Product or Sum, to the given Multiplicand, aud the Sum is the Product therefore by (3;) and ſo adding every new Product or Sum to the given Number, we may get the Products to the ſaid Numbers multiplied by all the ſingle Figures.

2. Put each Figure in the ſame (horizontal) Row with the product it produceth, in a Column to the Left-Hand, as in the Margin, and then the Table is conſtructed.

3. A Number is multiplied by 10 if a Cypher be put before it. Whence we get a moſt eaſy Proof of the Truth or Error of the Operation; for, if the Product of the given Number by 9 be added to the ſaid given Number, we get the Product thereof by 10 which, if it comes out the ſaid given Number with a Cypher annexed, proves every Product right, otherwiſe ſome Error is contracted.

THE USE.

The Uſe is evident, for let the given Multiplier be 123456789.

987654321

```
           987654321
           123456789
          ----------
          8888888889
         7901234568
        6913580247
       5925925926
      4938271605
     3950617284
    2962962963
   1975308642
  987654321
------------------
121932631112635269
------------------
```

Look for the firſt Figure 9 in the Column of ſingle Figures, and the Number in the ſame Line or horizontal Row is the firſt Product, and in the ſame Manner we find the Products by the other Figures of the Multiplicand ſucceſſively, which we place and add as before taught.

To prove Multiplication.

Make the Number which was the Multiplicand, Multiplier, then multiplying as uſual, if the Product be the ſame, the Work is right.

Thus to prove the firſt example in Caſe II.

```
Multiply     517
      by    3042
            ----
            1034
           2068
          15510
         -------
         1572714   Product the ſame as
         -------     there found.
```

QUESTIONS IN MULTIPLICATION.

Q. What doth *Multiplication* teach?

A. From two Numbers given to find a third, which ſhall contain one of the given Numbers as often as the other contains Unity.

Q. What are the Numbers called?

A. 1. The Number to be multiplied is called the Multiplicand; the Number we multiply by, the Multiplier; And the Number found, the Product.

Q. How

Q. How is *Multiplication* performed when the Multiplier is a ſingle Figure?

A. Of th' Units o' th' Multiplicand
And given Figure, th' Product find;
Put down the Product-Units, and
The Tens (if any) keep in Mind:
The given Tens next multiply:
The product of theſe Tens encreaſe
By the Tens reſerved by:
And ſo proceed from Place to Place.

Q. When the Multiplier is any number, or conſiſts of ſeveral Figures.

A. 1. Multiply the Multiplicand by the Units Figure of the Multiplier; then by Tens, and ſo ſucceſſively by every other Figure.

2. Let the Units-Figure of each Product ſtand in the ſame Place with the multiplying Figure, &c.

3. Add all the Products together.

Q. When Cyphers are intermixed with the ſignificant Figures of the Multiplier?

A. Multiply the ſignificant Figures only, ſtill obſerving to put the Units-Figure of the Product in the ſame Place with the multiplying Figure.

Q. How muſt we prove the Work of *Multiplication?*

A. Make the Multiplicand Multiplier.

Q. Repeat the *Multiplication Table?*

A. Twice 2 is 4, &c.

CHAP. V.

DIVISION.

DIVISION teacheth to find how often one given Number is contained in another.

The Number which divides is called the *Diviſor.*

The Number which is to be divided is called the *Dividend.*

And the Number found by dividing the Greater by the Leſs is called the *Quotient.*

Caſe I.

When the Diviſor is a ſingle Figure, and the Dividend no more than two, and the Diviſor meaſures the Dividend.

Rule.

Conſider what Number multiplying the Diviſor will produce the Dividend, and that Number is the Quotient.

Example.

Examples.

[1]	[2]	[3]	[4]
3] 25	3] 21	4] 16	5]35
[5]	[6]	[7]	[8]
6] 30	8] 72	9] 54	7] 56

When the Divisor doth not measure the Dividend.

Rule.

Consider what Number multiplying the Divisor will make a Product next less than the Dividend, and that is the Quotient Figure sought.

2. Multiply the Divisor by the Quotient-Figure, and place the Product under the Dividend.

3. Subtract the Product from the Dividend, and if the Remainder be less than the Divisor, the Quotient-Figure is truly taken.

Examples.

[9]	[10]	[11]	[12]	
2] 15	3] 25	3] 29	4] 37	
[13]	[14]	[15]	[16]	[17]
5] 28	6] 34	7] 48	8] 57	9] 39

When the Divisor is a single Figure and the Dividend any Number.

Rule.

Take the Divisor in the last or highest Figure of the Dividend, if it be greater than the Divisor, but if not find how often the Divisor is contained in the two last Figures of the Dividend, and having found the Quotient-Figure, proceed exactly as in the last §. and find the Remainder, as there taught.

2. To the Remainder (if any) bring down the next lower Figure, and let the Number expressed by these two Figures be esteemed a new Dividend: or if there be no Remainder then esteem the next lower Figures of the Dividend a new Dividend, which divide in like Manner as in last §. and place the Quotient Figure to the Right-Hand of that first found.

3. Proceed in the like Manner from Figure to Figure, till the Figures of the Dividend be taken down successively one by one.

Case II.

When the Divisor is any Number whatever.

The Procefs is exactly the fame as in laft Cafe, only the Difficulty of determining the Quotient-Figure is greater, to render which eafy, obferve the following Rules:

1. By Means of the laft, or two laft Figures of the Divifor compared with as many, if greater, or, if not, one more of the Dividend, difcover the Quotient-Figure as near as may be.

2. If the Product of the Quotient Figure multiplied by the Divifor be greater than the affumed Member of the Dividend, the Quotient-Figure is too great, wherefore make it lefs.

3. If the Remainder, after the Product is fubtracted from the Divided Member, be greater than the Divifor, the Quotient-Figure is too little and muft be made greater.

4. If neither of thefe happen, the Quotient-Figure is truly found.

QUESTIONS AND PRACTICAL EXAMPLES.

Q. What is *Divifion?*

A. The finding how often one given Number is contained in the other.

Q. What are the given Numbers called?

A. The leffer is called the *Divifor*, [i. e. *the Divider*,] and the greater the *Dividend*, [i. e. *the Number to be divided*.]

Q. What is the Number found called?

A. The *Quotient*, which fhews how often the Divifor is contained in the Dividend.

Q. How is the Quotient found?

A. Seek how often the Divifor is contain'd
I'th' leading Figures of the Dividend;
So the firft Quotient Figure's found: which by
The giv'n Divifor we muft multiply;
The Product take from what we did divide;
Next Figure put by the Remainder's Side:
Repeat the Procefs, until one by one,
The Figures of the Dividend are gone.

Q. How fhall I know when the Quotient-Figure is truly found?

A. When the Product of the faid Figure and the Divifor is lefs than the divided Member; and the Remainder lefs than the Divifor.

Problem.

Q. Suppose I bring down the next Figure of the Dividend to the Remainder, and the Number is still less than the Divisor?

A. Put o for the Quotient-Figure, and take down the next Figure of the Dividend.

Q. How must I prove *Division*?

A. Multiply the Quotient by the Divisor (adding in the Remainder, if any) and if the Product be equal to the Dividend, the Work is right.

Examples.

[18] 2] 3754638 [[19] 3] 42754372 [
[20] 4] 2608735 [[21] 5] 796047320 [
[22] 6] 47345243 [[23] 7] 187342358 [
[24] 9] 34227234 [[25] 11] 472430734 [
[26] 12] 348073620 [

It is usual in Practice to put down the Quotient only, performing the rest of the Operation by Memory.

[27] 2] 43782
21891
[28] 3] 784375 [
[29] 4] 2724865 [30] 5] 74340845
[32] 7] 3425168 [31] 6] 75324374
[34] 9] 352463 [33] 8] 54372582
[35] 11] 34267345

Case II.

Examples.

[36] 27] 34865372 [[37] 83] 54768724 [
[38] 47] 3986294823 [[39] 53] 79852375 [
[40] 325] 3784270981 [[41] 4376] 2428907324 [

[42] 53428] 824675402378 [
[43] 753364] 5864732164372 [
[44] 6398607] 2835729034758 [
[45] 137864272] 5430726894136 [

Case III.

When the Divisor hath Cyphers in its lowest Place, cut off the Cyphers (with a dash of the Pen) and as many of the lowest Figures of the Dividend; and then divide the other Figures of the Dividend by the significant Figures of the Divisor, as before taught; and the Figures cut off from the Dividend must be brought down to the Remainder, if not Cyphers.

Application.

```
56|00) 75489|32 (1347
       56
       ---
       194
       168
       ---
        268
        224
        ---
         446
         392
         ---
         5432
```

Examples.

[46] 2400) 72579482 [47] 3600) 7529176586

[48] 3000) 427587761 [49] 9000) 6876752871

[50] 9000) 4786560000 [51] 4720) 6843248

[52] 20) 3724865 [53] 37482000) 4786527725814

When

† *Case* IV.

When the Divisor is such a Number, that any two Figures [in the Multiplication Table] being multiplied together, will produce the said Divisor.

Rule.

Divide the given Number by one of these Figures, and that Quotient again by the other, which will give the Quotient required.

Note, If there be a remainder in the last Division, it will be so many Times the first Divisor, which added to the first Remainder [if any] will give the true one.

Examples.

54. Divide 1205817 by 16. (55) 42768 by 48.
56. 14652 by 64. (57) 74682 by 72. (58) 417681 by 81.
59 34672 by 108. (60) 217904 by 120. (61) 14276 by 144.

Case V.

Division may be performed with much Ease and Certainty by constructing a Table of the Products of the Divisor multiplied by the single Figures, in the same manner as the Table of the Multiplicand was constructed [Page 30.]

Application.

```
 1 |  987654321]  121932631112635269 [123456789
 2 | 1975308642    987654321........
 3 | 2962962963   ----------
 4 | 3950617284   2316719901
 5 | 4938271605   1975308642
 6 | 5925925926   ----------
 7 | 6913580247    3414112592
 8 | 7901234568    2962962963
 9 | 8888888889    ----------
10 | 9876543210     4511496296
                    3950617284
                    ----------
                     5601720123
                     4938271605
                     ----------
                      6705185185
                      5925925926
                      ----------
```

7792592592
6913580247

8791023456
7201234568

8888888889
8888888889

The Use of this Table is very easily apprehended: For we find the first Member of the Dividend as before, *viz.* the same Number of Figures as the Divisor hath, if the highest Figures of the Dividend be greater than the highest of the Divisor, or one more, if less: Then look in the Table for that Product which is immediately next less than the first Member of the Dividend, and place it under the said Member; and the Figure in the Column to the Left hand is the Quotient Figure, which is thus known, without any doubtful Trials, as before. The rest of the Work is the same, as in the Common Method before taught. This Method may be of great Use to a Learner, and likewise in making large Divisions.

PROBLEMS

RESULTING FROM THE COMPARISON OF THE PRECEDING RULES.

Problem I.

Having the Sum of two Numbers and one of them given to find the other.

Subtract the given Number from the given Sum, and the Remainder will be the Number required.

Example.

Let 144 be the Sum of two Numbers; one of which is 96, the other is required.

From 144 the Sum
Take 96 the given Number

Remain 48 the other

Proof 144

Problem.

Problem II.

Having the greater of two Numbers, and the Difference between it and the leffer given, to find the leffer.

Subtract the one from the other.

Example.

From 144 the Greater
Take 96 the Diff.

Remains 48 the leffer.

Problem III.

Having the leffer of two Numbers given, and the Difference between it and a greater, to find the greater.

Add them together.

Given $\left\{ \begin{array}{l} \text{96 the leffer Number} \\ \text{48 the Difference} \end{array} \right.$

Sum 144 the greater Number required.

Problem IV.

Having the Product of two Numbers, and one of them given to find the other.

Divide the Product by the given Number, and the Quotient will be the Number required.

Let the Product of two Numbers be 144, and one of them 3; I demand the other?

3) 144

Answ. 48

Problem V.

Having the Dividend and Quotient to find the Divifor.

Divide the Dividend by the Quotient.

Cor. Hence we get another Way of proving *Division.*

Problem VI.

Having the Divisor and Quotient given, to find the Dividend.

Multiply them together.

Now by a due Consideration and Application of these Problems only, the following Questions may be resolved in a short and elegant Manner, altho' some of them are generally supposed to belong to higher Rules.

QUESTIONS.

1. What Number is that, which being added to 9709 makes 10901? *Answer*, 1192.

2. The lesser of two Numbers is 9709, the Difference between them is 1192; what is the greater? *Answ.* 10901.

3. What Number must I multiply by 7 that the Product may be 623? *Answer*. 89.

4. The Product of two Numbers is 31383450, and one of them 4050; the other Factor is required? *Answ.* 7749.

5. What is the Difference, and what the Sum of six Dozen Dozen, and half a Dozen Dozen? *Ans.* Diff. 792. Sum 936.

6. The Sum of two Numbers is 360; the less 114: What is their Difference and Product?

Answer, 132 and 28044.

7. The Remainder of a *Division* Sum is 423; the Quotient 423; the Divisor is the Sum of both and 19 more: What then was the Number to be divided? *Ans.* 366318.

8. There is a certain Number, which being divided by 7, the Quotient resulting multiplied by 3, that Product divided by 5, from the Quotient subtract 20, to the Remainder add 30, and half the Sum shall make 35? *Ans.* 700.

$$\frac{35\times2-30+20\times5\times7}{3}$$

9. What Number added to the forty-third Part of 4129 will make the Sum 240? *Answ.* 137.

10. What Number deducted from the 26th Part of 2262 will leave the 87th Part of the same? *Answ.* 61.

11. A Sheepfold was robbed three Nights successively; the first Night half the Sheep were Stolen, and half a Sheep more; the second, half the Remainder were lost, and half a Sheep more; the last Night they took half what were left, and half a Sheep more; by which Time they were reduced to 20: How many were there at first? *Ans.* 167.

12. What Number multiplied by 72084 will produce 5190048? *Answer,* 72.

13. There are two Numbers; the greater of them is 73 Times 109, and their Difference 17 Times 28. I demand their Sum and Product? *Ans.* 15438 and 59526317.

OF NUMBERS OF DIVERS DENOMINATIONS.

NUMBERS of divers Denominations are those whereby we express the sundry Denominations or Divisions of Money, Weights and Measures.

1. *Of* Money.

In *England* and *Ireland* Accounts are kept in Pounds, Shillings and Pence, which are compounded as follow.

4 Farthings make 1 Penny
12 Pence ——— 1 Shilling
20 Shillings —— 1 Pound.

Abbreviations.

d. Pence *s.* Shillings. £. Pounds

Farthings are expressed as Parts of a Penny, thus:

$\frac{1}{4}$ expresses One Farthing.
$\frac{1}{2}$ ——— One Halfpenny,
$\frac{3}{4}$ ——— Three Farthings.

But Payments are made in the following Coins:

Gold Coins.	Weighing pwt.	gr.	Current in *England* at l.	s.	d.	Current in *Ireland* at l.	s.	d.
Portugal Piece	18	10½	3	12	0	3	17	8
Half ditto	9	5¼	1	16	0	1	18	10
Quarter ditto	4	14½	0	18	0	0	19	6
⅛ ditto	2	7¼	0	9	0	0	9	10
A Moydore	6	22	1	7	0	1	9	3
Half ditto	3	11	0	13	6	0	14	8
Quarter ditto	1	17½	0	6	9	0	7	4
Guinea	5	8	1	1	0	1	2	9
Half Guinea	2	16	0	10	6	0	11	4½
A *Louisd'or* or *French* Pistole	4	8				0	18	3
Half ditto	2	4				0	9	2

Silver Coins.	Current in *England* at s.	d.	Current in *Ireland* at s.	d.
A Crown Piece	5	0	5	5
Half ditto	2	6	2	8½
An *English* Shilling	1	0	1	1
Half ditto	0	6	0	6½

Farth.	Pence	Shilling	Pound
4	1		
48	12	1	
960	240	20	1

2. *TROY WEIGHT.*

By *Troy-Weight* are weighed Gold, Silver, Jewels, and Liquors.

The Denominations are,

24 Grains	make	1 Penny-weight,
20 Penny-weights	make	1 Ounce,
12 Ounces	make	1 Pound.

Abbreviations.

Abbreviations.

℔ Pounds, *dwts.* Penny-weights,
oz. Ounces, *grs.*

Grains	P. weights		
24	1	Ounces	
480	20	1	Pound
5760	240	12	1

3. *AVOIRDUPOISE WEIGHT.*

Is the Weight generally uſed for weighing Goods of all Kinds, (the above excepted) and its Diviſions are as follow:

16 Drams	make	1 Ounce,
16 Ounces	———	1 Pound,
14 Pounds	———	1 Stone,
28 Pounds	———	1 Quarter of a Hundred
4 Quarters or 112 Pound	—	1 Hundred Weight,
20 Hundreds	———	1 Tun.

Abbreviations.

drs. Drams, *qrs.* Quarters,
oz. Ounces, *Cwt.* Hundred weight.
℔. Pounds

Note, 16 Pound is a Stone of Wool in *Ireland*:
Therefore 7 Stone of Wool is 1 Cwt.

Drams	Ounces					
16	1	Pounds				
256	16	1	Stones			
3584	224	14	1	Qrs.		
7168	448	28	2	1	Cwt.	
28672	1792	112	8	4	1	Tun
573440	35840	2240	100	80	20	1

4. *APOTHECARIES' WEIGHT.*

By the following Diviſions Apothecaries compound their Medicines;

Medicines; but buy and sell by *Avoirdupoise* Weight.

20	Grains	make	1 Scruple,
3	Scruples	——	1 Dram,
8	Drams	——	1 Ounce,
12	Ounces	——	1 Pound.

Abbreviations.

grs. Grains,	℥ Ounces,
℈ Scruples,	℔ Pounds
ʒ Drams	

5. *CLOTH-MEASURE.*

4	Nails	make	1 Quarter of a Yard,
4	Quarters	——	1 Yard,
3	Quarters	——	1 Ell *Flemish*,
5	Quarters	——	1 Ell *English*,
6	Quarters	——	1 *French* Ell.

Abbreviations.

Na. Nails,	E. *F.* Ells *Flemish*,
qr. Quarter,	E. *E.* Ells *English*,
Yd. Yard,	*F.* E. *French* Ell.

6. *LONG-MEASURE.*

This is used to measure the Distances of Places one from another, and every Thing where Length only is considered; likewise to take the Dimensions of the Length, Breadth, and Thickness of all Bodies. Its Divisions are as follow:

3	Barley-Corns	make	1 Inch,
12	Inches	——	1 Foot,
3	Feet	——	1 Yard, 2 Yards 1 Fathom,
$5\frac{1}{2}$	Yards	——	1 *English* Perch,
7	Yards	——	1 *Irish* Perch,
40	Perches, or Poles	——	1 Furlong,
8	Furlongs	——	1 Mile,
3	Miles	——	1 League,
$69\frac{1}{2}$	*English* Miles	——	1 Degree of a great Circle,
$54\frac{17}{28}$	*Irish* Miles	——	1 Degree of a great Circle,
360	Degrees	——	A Great Circle of the Earth.

Or

Or in measuring Distances.

$7\frac{92}{100}$ Inches make 1 Link *English*,
$10\frac{8}{100}$ Inches —— 1 Link *Irish*,
25 Links —— 1 Perch,
100 Links —— 1 Chain,
10 Chains —— 1 Furlong,
8 Furlongs —— 1 Mile.

Inches	Feet	Yards	Perches	Furlongs	Mile
12	1				
36	3	1			
252	21	7	1		
10080	840	280	40	1	
80640	6720	2240	320	8	1

English	Inches	Links	Poles or Per.	Chains	Furl.	Mile.
$7\frac{92}{100}$	$10\frac{8}{100}$	1				
198	225	25	1			
792	1008	100	4	1		
7920	10080	1000	40	10	1	
63360	80640	8000	320	80	8	1

Note, The last Column to the Left-hand marked *English*, shews the Inches in the *English* Pole, Chain, &c. and the next marked Inches shews the Inches in the *Irish*.

7. *SQUARE-MEASURE.*

Is used in finding the Contents of Surfaces, when we measure both the Length and Breadth.

144 Square Inches make 1 Square Foot,
9 Square Feet —— 1 Square Yard,
49 Square Yards —— 1 Square Perch,
40 Square Perches—— 1 Rood,
4 Roods —— 1 Acre.

ENGLISH SQUARE MEASURE.

$30\frac{1}{4}$ Square Yards, 1 Square Perch,
$39\frac{1}{16}$ Square Yards, 1 Square Perch, Cunningham-Measure.

Otherwise

Otherwise thus:

$7\frac{92}{100}$ Inches	make	1	Link *Eng.* Measure,
$10\frac{8}{100}$ Inches	——	1	Link *Irish*,
625 Links Square	—	1	Square Perch,
100,000 Square Links	—	1	Acre.

8. *LIQUID-MEASURE.*

4 Naggins	make	1	Pint,
2 Pints	——	1	Quart,
2 Quarts	——	1	Pottle,
2 Pottles	——	1	Gallon.*
42 Gallons	——	1	Tierce,
63 Gallons	——	1	Hogshead,
84 Gallons	——	1	Puncheon,
2 Hogsheads	——	1	Pipe or Butt,
2 Pipes	——	1	Tun.

Pints	Quarts								
2	1	Pottles							
4	2	1	Gal.						
8	4	2	1	Tierces					
336	108	84	42	1	Hogsh.				
504	252	126	63	$1\frac{1}{2}$	1	Punch.			
672	336	168	84	2	$1\frac{1}{3}$	1	Pipe or But.		
1008	504	152	120	3	2	$1\frac{1}{2}$	1	Tun.	
2016	1008	504	252	6	4	3	2	1	

9. *DRY-MEASURE.*

Is used to measure Corn and other dry Goods; but as they are generally sold by weight in *Ireland*, this Measure is little used; however the Denominations are as follow, *viz.*

2 Pints

* The Gallon appointed to be used for measuring all Kinds of Liquids in *Ireland* is $217\frac{6}{10}$ Cubic Inches, and 40 Gallons are a barrel of Ale, tho' the Vessel usually holds 42.

In *England* the Wine Gallon is 231; and the Beer or Ale Gallon 282 Cubic Inches.

2 Pints	make	1	Quart,
2 Quarts	——	1	Pottle,
2 Pottles	——	1	Gallon,
2 Gallons	——	1	Peck,
4 Pecks	——	1	Bushel,
4 Bushels	——	1	Barrel,
2 Barrels	——	1	Quarter.

10. *TIME.*

60 Seconds	make	1	Minute,
60 Minutes	——	1	Hour,
24 Hours	——	1	Day,
7 Days	——	1	Week,
365 Days	——	1	Year.

Addition *of Numbers of divers Denominations.*

Rule.

PLACE the Numbers so, that those which are of the same Denomination stand exactly underneath each other. Then Beginning with the Figures of the lowest or least Denomination, add them together into one Sum, divide this Sum by that Number which 1 of the next higher contains of the Denomination added, the Remainder set down underneath the added Figures, and carry the Quotient Figure to be added with the Figures of the next superior Denomination, and so proceed from one Denomination to another until all be finished.

PENCE TABLE.

	s.	d.		s.	d.
20 Pence is	1	08	110 Pence is	9	02
30 ——	2	06	120 ——	10	00
40 ——	3	04	130 ——	10	10
50 ——	4	02	140 ——	11	08
60 ——	5	00	150 ——	12	06
70 ——	5	10	160 ——	13	04
80 ——	6	08	170 ——	14	02
90 ——	7	06	180 ——	15	00
100 ——	8	04			

Exam-

Examples of Money.

[1]	l.	s.	d.	[2]	l.	s.	d.
	710	11	06		516	14	08
	616	14	03		319	18	06
	419	15	07		724	17	09

[3]	l.	s.	d.	[4]	l.	s.	d.
	965	19	11		998	18	02
	876	17	09		873	01	09
	742	10	01		175	12	03
	967	19	10		789	14	06
	435	14	11		966	10	06

[5]	l.	s.	d.	[6]	l.	s.	d.
	306	02	08		1342	03	01
	1090	13	01		827	11	11
	984	12	03		371	14	03
	442	13	00		1208	17	09
	653	11	09		799	17	06

[7]	l.	s.	d.	[8]	l.	s.	d.
	105	17	7		940	10	07
	193	19	11		28	11	06
	1200	13	0		308	18	04
	319	19	7		1008	11	04
	1004	04	11		153	12	09
	96	16	6		380	13	07
	111	09	9		1003	14	06
	976	13	10		796	17	06
	449	12	6		874	16	07
	7	14	11		9	03	05

[9]	l.	s.	d.
	999	18	11
	808	17	10
	777	18	01
	666	16	09
	505	15	08
	677	13	07
	333	12	06
	735	11	05
	313	10	01
	331	19	03
	113	17	01
	419	14	04

[10]	l.	s.	d.
	177	18	11
	878	19	10
	909	06	11
	1851	17	10
	765	17	02
	983	10	03
	1796	11	05
	641	13	04
	1351	15	07
	235	16	06
	7	07	07
	1065	11	03

[11]	l.	s.	d.
	875	18	09½
	1898	17	08
	798	19	09¾
	896	18	11
	1768	05	09¼
	585	16	08
	1679	14	10½
	898	17	07
	1199	16	09¾
	426	13	02¼
	1519	12	09

[12]	l.	s.	d.
	1007	17	07½
	489	19	09
	1998	17	10¾
	996	16	11
	1548	18	05½
	798	15	05
	1654	11	04¾
	607	14	03
	1596	14	07½
	849	13	03
	1700	00	00¾

[13]	l.	s.	d.
	1695	18	10
	4304	17	09
	3975	15	03
	8169	10	11
	7594	11	10
	9150	13	10
	3329	19	11
	1904	10	07
	4985	04	02
	6403	16	10
	9108	19	10
	2399	18	11
	6624	12	09

[14]	l.	s.	d.
	9790	17	10½
	7549	18	07
	6854	15	09½
	8162	18	04
	9971	12	06½
	8986	11	11
	3796	14	10¾
	9875	13	11
	6914	15	10½
	7896	17	04
	9713	18	06½
	9162	15	11
	6397	19	10¼

110368

[15] l.	s.	d.
1103682	15	11¾
19020	17	04
1032	19	08¾
50233	16	04¾
1006	13	02
103021	17	04½
2071069	18	10
104	12	06¼
503019	08	00¼
50017	15	04
1188	10	03
106	18	06½
9986	17	11
93009	03	08¼
170066	18	02
31117	17	06½
5006	08	08¼
4117	05	04
2118	03	11¾
12144	18	08
3331	12	07½
113217	16	06
172101	17	03
1716	16	10
14	13	05¼
179	19	07
20016	18	07
8003	14	06¼
3	07	06½

[16] l.	s.	d.
18101935	15	04
16173260	18	03½
17121960	14	06
1218130	18	06½
154188	13	07¾
176099	09	11
136033	17	10½
13093	02	07½
121966	14	05
13666	12	08½
27333	13	04½
17613	19	08*
27333	18	06½
3217	12	08
13666	12	04½
1832999	17*	02½
466	06	05½
1783	13	07
18926	19	11¼
17412	18	06
176849	13	07½
832191	13	07
182	06	06½
1827	09	07
32115	08	11¾
36419	16	08¾
177722	16	02
1133219	17	03¼
11991	19	08¼
1	12	3¾

Note, where the Columns of the Money to be added are long (as frequently happens in Business) it is troublesome and liable to Error to collect them into one continued Sum: To remedy which, *Practice* hath suggested sundry Contrivances for Ease and Dispatch: Some point for every 12 in Pence, and every 20 in Shillings; this is esteemed inelegant and un-Clerk-like; but instead thereof we may very conveniently point in Pence at 120 or 10*s*. In shillings and Pounds at 100, and then we must carry 10 for every Point. By ap-

plying

2. *Troy-Weight.*

[17] lb	oz.	dwt.	gr.	[18] lb	oz.	dwt.	gr.
868	11	15	23	809	06	09	07
239	10	10	20	908	10	15	23
157	05	13	19	089	01	04	20
455	10	09	18	876	07	19	20
559	09	18	05	789	07	08	14
254	10	05	01	570	06	04	10

3. *Avoirdupoise-Weight.*

[19] C.	qrs.	lb	[20] C.	qrs.	lb
943	2	11	1153	1	09
386	3	25	151	2	22
479	2	27	1519	3	21
421	3	19	195	0	19
784	1	26	1567	1	23
234	2	09	567	2	01
432	3	03	1267	3	09
867	1	06	2643	1	11

plying this to the last Example (Page 50) my Meaning may be more clearly apprehended.

First then adding the Farthings, I find them 35, *i. e.* 8*d.*$\frac{3}{4}$: carry 8; Then say 8 I carry and 8 is 16, &c. up to the Sum *17613 19 8$\frac{1}{2}$, where the Pence amount to 124: I point for 120 or 10*s.*; and then proceed saying 4 and 4 is 8, &c. to the Top where the Sum amounts to 75*d. i. e.* 6*s.* 3*d.*; put down 3 and carry 6+10 for the point, *i. e.* 16 to the Shillings; Then I begin with the Units of Shillings and say 16 I carry and 9 is 25 and 7 is 32, &c. up to the Line *1832999 17 2$\frac{1}{2}$, where the Sum amounts to 106: I point for a 100 and carry 6; and so adding to the Top, when the Sum is 82, I set down two and carry 8+10 for the Point, *i. e.* 18 to the Tens of Shillings, which I count up, saying 18, 19, 20, &c. up to the Top where they amount to 41. Then since every 2 Tens make 20 Shillings or 1*l.*, I say half of 41 is 20 and 1 over, which odd 1 remaining is to be put to the 2's before set down to make it 12, &c. Then carry the 20 and proceed to the Pounds, and make a Point for every 100 in like Manner.

Note, Some chuse to point at 60 or 5*s.* in the Pence.

[21]	*Tun*	*C.*	*qrs.*	*lb*	[22]	*lb*	*oz.*	*dr.*
	194	19	3	21		27	10	10
	890	13	2	15		17	08	04
	908	16	1	24		25	13	03
	577	18	0	23		29	12	11
	789	15	2	27		16	10	15
	865	14	3	26		26	14	08
	468	14	2	23		17	15	13
	779	16	3	16		24	10	05

Liquid-Measure.

[23]	*Tun*	*Hhd.*	*Gal.*	[24]	*Tun*	*Hhd.*	*Gal.*
	31	3	59		85	1	61
	29	2	41		84	2	59
	54	3	62		97	3	40
	25	1	39		69	0	59
	31	1	62		53	3	29

[25]	*Hhd.*	*Gal.*	*Pints*	[26]	*Tun*	*Hhd.*	*Gal.*	*Pints*
	27	53	1		4	3	59	2
	17	29	3		7	1	60	3
	25	17	5		6	2	15	4
	37	45	4		2	0	24	7
	13	19	6		3	3	38	1
	25	28	2		5	1	27	0

Subtraction of divers Denominations.

Rule.

PLACE each Denomination under that of the same Kind: Then begin with the lowest Denomination and subtract it from the Number of the same Denomination above it, (if it be greater) but if the lower Denomination be greater, then subtract it from the Number which one of the

the next higheſt contains of the lower Denomination, and to the Remainder add the upper Number of the lower Denomination, the Sum is the true Remainder required: Then ſubtract the next higher Denomination of the lower Line from 1 leſs than the Number of the ſame Denomination in the upper; or elſe add 1 to the lower and ſubtract the Sum from the upper; and thus proceed from one Denomination to another untill all be ſubtracted.

Examples *of* Coin.

[1]	*l.*	*s.*	*d.*	[2]	*l.*	*s.*	*d.*
Received	1098	19	10		979	15	11
Paid	134	15	08		200	19	11

[3]	*l.*	*s.*	*d.*	[4]	*l.*	*s.*	*d.*
Received	9275	02	03		8500	19	07
Paid	7869	19	11		985	18	09

[5]	*l.*	*s.*	*d.*	[6]	*l.*	*s.*	*d.*
Received	1000	19	09¼		4351	17	10½
Paid	999	09	11½		2359	19	11¾

[7]	*l.*	*s.*	*d.*	[8]	*l.*	*s.*	*d.*
Received	14931	16	10		3687	07	08¾
Paid	14919	17	09½		1457	19	06¼

Troy-Weight.

[9]	lb	*oz.*	*dwt.*	*gr.*	[10]	lb	*oz.*	*dwt.*	*gr.*
Bought	554	9	19	23		946	00	00	01
Sold	97	0	17	15		125	11	17	23

Bought

[11]	lb	oz.	dwt.	gr.	[12]	lb	oz.	dwt.	gr.
Bought	304	11	15	13		917	0	14	09
Sold	196	10	19	21		798	9	18	17

Avoirdupoise Weight.

[13]	C.	qrs.	lb	[14]	C.	qrs.	lb
Bought	200	2	26		275	2	15
Sold	99	3	15		27	2	07

[15]	C.	qrs.	lb	[16]	C.	qrs.	lb
Bought	6040	1	21		1937	0	00
Sold	1908	3	27		889	3	27

[17]	C.	qrs.	lb	[18]	C.	qrs.	lb
From	8340	2	03		9074	3	25
Take	1090	3	16		7849	1	16

[19]	Tuns	C.	qrs.	lb	[20]	Tuns	C.	qrs.	lb
Bought	6904	16	3	11		7650	10	0	13
Sold	987	14	0	27		4876	10	3	25

Liquid Measure.

[21]	Tun	Hbd.	Gal.	[22]	Tun	Hbd.	Gal.
Bought	31	3	15		54	0	27
Sold	29	2	26		21	3	42

[23]	Tun	Hbd.	Gal.	[24]	Tun	Hbd.	Gal.
Bought	304	0	54		721	1	33
Sold	109	3	54		247	2	11

QUES-

QUESTIONS.

Shewing the Use of Addition *and* Subtraction *of Money.*

Belfast, 5th of *July*, 1797.

1. Bought of George Grocer,

12*C.* 2*qrs.* of Sugar, at 52*s.* *per Cwt.*	£.	32	16	3
28lb of Rice, at 3*d.* *per* lb —		0	07	0
10 Loaves of Sugar, Wt. 35lb, at 1*s.* 1*d.*		1	17	11
5*C.* 2*qrs.* 12lb of Raisins, at 36*s.* *per C.*		6	18	10
20lb of Tea, at 5*s.* 6*d.* *per* lb —		5	10	0

2. Laid out at Market, *viz.*

For Meat, Seven Groats and Two-pence
Butter, Fourteen Pence —
Onions, Five Farthings —
Eggs, Three Halfpence —
Linen, Two-and-Twenty-pence
Potatoes, a Groat — —

0 6 $0\frac{3}{4}$

3. How much is the Sum of
Seven and thirty Shillings and Sixpence
Nine and thirty Shillings and Three-Halfp.
Four and forty Shillings and Nine-Pence
Twenty-nine Shillings and Three-Pence
Fifty Shillings? —— ——

Answ. £. 10 0 $7\frac{1}{2}$

4. A Nobleman going to the Country, orders his Tradesmen's Bills for Payment, which are as follow, *viz.* the Brewer's *l.*41 10, the Butcher's 212*l.* 6*d.* the Baker's 24*l.* the Tallow-chander's *l.*13 8, the Taylor's *l.*137 9 9, the Draper's *l.*74

*l.*74 13 6, The Coach-maker's *l.*214 16 6, The Wine Merchant's *l.*68 12, The Confectioner's *l.*16 2, His Rent 50*l.* His Servants' Wages came to *l.*46 5, and he would carry with him 50*l.* to defray his Expences: For what Sum must he draw on his Banker to answer all these?

Answer, *l.*948 17 3.

5. Receiv'd of *Peter Paywell* in Payment of his Bill of 10*l.* 1 *Portugal* Piece of *l.*3 17 8, 2 Moydores, 2 Guineas and a half, a Crown and 1 half Crown: I desire to know whether I must receive or return Change, and how much?

Answer, I must return 1*s.* 2*d.*

6. Bought 6 Bags of Hops weighing, *viz.* No. 1. 2*C.* 2*qrs.* 10lb; No. 2. 2*C.* 1*qr.* 16lb; No. 3. 2*C.* 0*qrs.* 24lb; No. 4. 2*C.* 3*qrs.*; No. 5. 2*C.* 1*qr.* 12lb; and No. 6. 2*C.* 1*qr.* 16lb. How many Cwt. have I bought?

Answer, 14*C.* 2*qrs.* 22lb.

7. In a Gentleman's Service of Plate there are 14 Dishes weighing 16lb 10*oz* 13*dwt*; 36 Plates weighing 35lb 10*oz* 11*dwt*; 6 Salts weighing 2lb 8*oz*; Knives and Forks 6lb 11*oz* 9*dwt*; 4 Salvers 9lb 5*oz* 4*dwt*; Cups, Tankards, &c. 22lb 0*oz* 18*dwt*; a Silver Tea-kettle and Lamp 10lb 6*oz* 9*dwt*. What Quantity of Plate had the Butler under his Care? *Answer*, 102lb 11*oz.* 4*dwt.*

8. A Merchant's Clerk receives of sundry Persons for his Master, *viz.* of *A* 13*l.* and half a Crown; of *B* *l.*2 13; of *C* 2 Pistoles and half a Guinea; of *D* *l.*1 9 8½; of *E* 11*l.* and 6¼*d.*; of *F* a Moydore and 13 *English* Shillings; of *G* a Bank-note of 20*l.* of *H* 15*l.* and 3 Crown-Pieces over. I desire to know what sum he had in Charge?

Answer, *l.* 68 13 4¾.

9. A Merchant bought 600 salt Ox-hides weighing 561*C.* and 2lb, of which he sells 250 weighing 239*C.* 3*qrs.* 25lb I demand how many Hides he hath left, and what they weigh? *Answ.* 350 Hides weighing 321*C.* 0*qrs.* 5lb.

10. A Shop-keeper bought a Piece of Cloth containing 42 Yards for *l.*22 10, of which he sells 27 Yards for *l.*15 15. I demand how many Yards he hath left, and what they stand in? *Answ.* 15 Yards which stand in 6*l.* 15*s.*

11. A

11. A Merchant who had 209 Casks of Butter weighing 400*C.* 2*qrs.* 14*lb.* shipped off 173 Casks thereof weighing 213*C.* 2*qrs.* 27*lb.* I demand how many Casks he had left and their weight?

Answer, 36 Casks, containing 186*C.* 3*qrs.* 15*lb.*

12. What five Numbers of Pounds, Shillings and Pence all different, will make just 100*l.*?

13. Paid *A B*, in full for *E F*'s Bill on me for 75*l.* *viz.* I gave him *Richard Drawer*'s Note for *l.*7 12 6, *Peter Johnson*'s ditto for 5*l.* An Assignment on *Robert Dealer* for *l.*17 13 9½ In Bank Notes 40*l.*; the rest I make up in Cash. I want to know what Sum will make up the Deficiency? *Answer*, *l.*4 13 8½.

14. A Trader failing, was indebted to *A* *l.*71 12 6; to *B*, *l.*34 9 9; to *C*, *l.*16 18 8; to *D*, *l.*44; to *E*, *l.*66 7 6; to *F*, *l.*11 2 3; to *G*, *l.*19 19; to *H*, *l.*20; at the Time of this Disaster he had by him in Cash *l.*3 13 6; in Commodities *l.*23 10; in Houshold Furniture *l.*13 8 6; in Plate *l.*7 18 5; in a Tenement *l.*56 15; in recoverable Book Debts *l.*87 13 10; Supposing these Things faithfully surrendered to his Creditors, what will they lose by him? *Answ.* *l.*91 10 5.

15. Bought 5 Hogsheads of Sugar, Weight as follows.

		C.	*qrs.*	*lb.*		*qrs*	*lb.*
No. 10	Gross	7	1	18	Tare	3	12
11	——	6	3	24	——	3	04
12	——	6	2	14	——	2	25
13	——	7	0	05	——	3	08
14	——	7	3	26	——	3	19

I demand the nett Weight of the Sugar when the Tare is taken away? *Answer*, 31*C.* 3*qrs.* 19*lb.*

MULTIPLICATION OF DIVERS DENOMINATIONS.

Case I.

When the Multiplier is leſs than 12, multiply firſt the loweſt Denomination thereby, and manage the Product directly in the ſame manner as the Sum in *Addition of divers Denominations*, and ſo proceed from one Denomination to another until they all be multiplied.

Remark.

The Learner will with a little Practice, be able to perform all the Work of this Multiplication by the Memory. But as the Shillings may frequently be more than 12, in that Caſe, multiply the Units by the Multiplier, adding to the Product the Shillings reſerved in the Product of the Pence, and for every ten reſerve 1 to be carried, and ſet down the Remainder (or Overplus) above the Tens, for the Units of the Shillings in the Product: Then multiply the Tens, adding thereto the Tens reſerved from the Product of the Units, and divide the Sum by 2, the Quotient is the Pounds to be carried, and if 1 remains put it down in the ſecond Place of the Shillings in the Product.

Application.

Suppoſe as before the Sum to be multiplied is 5*l.* 13*s.* 6½*d.* where 2 is reſerved from the Product of the Pence——I multiply the Shillings thus, 4 times 3 is 12, and 2 I carry is 14, put down 4 and carry 1; then I ſay 4 times 1 is 4 and 1 I carry is 5, the half of 5 is 2, or 2 in 5 goes twice and 1 remains, ſo I put the 1 remaining in the ſecond (or Tens) Place of the Shillings, whereby the Shillings in the Product become 14, and reſerve the Quotient 2 to be carried to the Pounds.

l.	*s.*	*d.*
5	13	6½
		4
22	14	2
2)	5	
	2	1

Examples to Case I.

	l.	*s.*	*d.*			*l.*	*s.*	*d.*	
1. Multiply	1	7	6	by 2	2.	4	13	9	by 3
	l.	*s.*	*d.*			*Yds.*	*qrs.*	*na.*	
3. Multiply	0	17	8½	by 4	4.	13	2	2	by 5

Multiply

	C.	*qrs.*	*lb.*			*l.*	*s:*	*d.*		
5. Multiply	4	2	12	by 6	6.	12	18	$7\frac{1}{2}$	by 7	
	l.	*s.*	*d.*			*l.*	*s.*	*d.*		
7. Multiply	0	13	$6\frac{1}{2}$	by 8	8.	5	17	$10\frac{1}{2}$	by 9	
9. Multiply	1	8	4	by 10	*10.	13	16	8	by 11	

	C.	*qrs.*	*lb.*	
10. Multiply	6	2	24	by 12.

Case II.

When the Multiplier is greater than 12, but the Product or Composite of two Numbers both less than 12.

Rule.

Multiply first by one Component Part of the given Multiplier, and the Product so found multiply by the other; this last Product will be the Answer.

Application.

Let *l.*4 17 10, be given to be multiplied by 21.

Multiply first	4	17	10		
by			3	one component Part	21
And the Product	14	13	6		
by			7	the other compon. Part	
Answer,	102	14	6 by 21		

Examples.

	l.	*s.*	*d.*			*l.*	*s.*	*d.*
11. Multiply	1	8	4	by 21	*Answer,*	29	15	0
12. Multiply	0	17	$4\frac{1}{2}$	by 32	——	27	16	0
13. Multiply	1	10	8	by 44	——	67	9	4

	l.	*s.*	*d.*			*l.*	*s.*	*d*
14. Multiply	4	16	$3\frac{1}{2}$	by 56	*Answer,*	269	12	4
15. Multiply	3	17	8	by 64	———	248	10	8
16. Multiply	1	13	6	by 121	———	202	13	6
17. Multiply	0	18	3	by 72	———	65	14	0
18. Multiply	0	4	9	by 144	———	34	4	0

Case III.

When the Multiplier is not composite of two Numbers less than 12; but exceeds some such composite Number by a Number not greater than 12.

Rule.

For the composite Number next less than the given Multiplier, find the Product (*per* last Rule) then multiply the given Multiplicand by the overplus, (or Number by which the assumed composite Number is less than the given Multiplier) and add the Product together; the Sum is the Product required.

Application.

Let *l.* 1 17 $4\frac{1}{2}$, be multiplied by 23.

	l.	*s.*	*d.*	
Multiply	1	17	$4\frac{1}{2}$	
			3	[2
	5	12	$1\frac{1}{2}$	
			7	
	39	4	$10\frac{1}{2}$	Product by 21 *per* last,
	3	14	9	—by 2 the Overplus of 23 above 21;
Answer,	42	19	$7\frac{1}{2}$	—by 23.

Or

Or thus:

1	17	$4\frac{1}{2}$	22
		2	
3	14	9	
		11	
41	02	3	Product by 22,
1	17	$4\frac{1}{2}$	——by 1 the No. wanting to make 23,
42	19	$7\frac{1}{2}$	——by 23.

Examples.

		l.	*s.*	*d.*		*l.*	*s.*	*d.*
19.	Multiply	3	13	4 by 31	*Answ.*	113	13	4
20.	Multiply	1	11	6 by 23	——	36	4	6
21.	Multiply	0	16	$6\frac{1}{2}$ by 47	——	38	17	$5\frac{1}{2}$
22.	Multiply	1	18	10 by 68	——	132	0	8
23.	Multiply	1	2	9 by 75	——	85	6	3
24.	Multiply	0	16	8 by 112	——	93	6	8
25.	Multiply	0	5	5 by 139	——	37	12	11
26.	Multiply	1	15	$4\frac{1}{2}$ by 155	——	274	3	$1\frac{1}{2}$

QUESTIONS.

SHEWING THE USE OF THIS MULTIPLICATION.

1. *In casting up the Price of Goods.*

1. Bought a Piece of Broad-cloth containing 24 Yards at 15*s.* 3*d. per* Yard; what comes it to? *Answ. l.*18 6

2. What cost a Chest of Tea weighing 98 lb at 5*s.* 6*d. per* lb? *Answer, l.*26 19.

3. Bought 39*C.* of Butter at *l.*1 5 6 *per C.* what comes it to? *Answer, l.*49 14 6.

4. What cost 1 Hundred wt. of Sugar at $7\frac{1}{2}$ *per* lb? *Answer, l.*3 10.

5. Bought a Hogshead of Wine at 5*s*. 4*d*. *per* Gallon; what did it cost? *Answer*, *l* 16 16.

6. If I hold 120 Acres of Land at 14*s*. 6*d*. *per* Acre; what is my yearly Rent? *Answer*, 87*l*.

2. *In casting up Coins.*

A merchant sends his Clerk to the Bank to receive Cash for a note of *l*.75, which he receives in the following Species, *viz.*

	l.	*s.*	*d.*			*l.*	*s.*	*d.*
27 at	1	2	9	———	——			
23 at	1	9	1	———	——			
40 at	0	5	5	———	——			
		Change		———	——	00	00	2
						75		

Paid *Daniel Raymond* in full for *John Denham's* Bill on me, 100*l*. *viz.*

	l.	*s.*	*d.*		*l.*	*s.*	*d.*
60 at	1	2	9	———			
21 at	1	9	3	———			
1 at	0	19	6	———			
		Change		———	00	1	3
					100		

Received of *Abraham Accepter*, in full for *Rich. Drawer's* Bill on him, *l*.150, *viz.*

	l.	*s.*	*d.*		*l.*	*s.*	*d.*
36 at	1	18	10	———			
11 at	1	9	1	———			
153 at	0	5	5	———			
20 at	1	2	9	———			
					150	1	8
		Change returned		—		1	8
					150		

Received

Received of *D. B.* in full for Tobacco sold him 27th *Sep.* *l.*143 12 9, *viz.*

	l.	s.	d.		l.	s.	d.
29 at	1	9	3	——			
13 at	3	17	8	——			
28 at	0	18	3	——			
16 at	0	18	1	——			
115½ at	0	1	1	——			
16½ at	0	5	5	——			
					143	12	9

Paid *John Hammond* 250*l.* for 250 Barrels of Beef, *viz.*

	l.	s.	d.		l.	s.	d.
19 at	3	17	8	——			
25 at	3	17	6	——			
14 at	1	18	10	——			
20 at	1	9	3	——			
83 at	0	5	5	——			
8 at	0	1	1	——			
					250	0	1
				Received back —			1
					250		

Received of *James Thomas* 327*l.* for my Bill of 300*l.* *English*, which I have drawn on *C B* of *London*, at 9 *per Cent.*

	l.	s.	d.			s.	d.	l.	s.	d.
13 at	3	17	8	More,	3 at	9	10			
25 at	3	17	6	——	2 at	9	8			
14 at	1	18	10	——	1 at	9	2			
29 at	0	19	6	——	1 at	9	0			
27 at	0	19	4	——	2 at	4	11			
21 at	1	2	9	——	1 at	4	9			
7 at	1	9	3							
9 at	1	9	1					327	1	4
16 at	1	8	11	Returned					1	4
26 at	0	18	5							
								327		

A passed a Bond for *l.*114 10, the Interest came to 19*l.* He then paid off 40 Guineas, and gave a fresh Bond for what was behind. By the time there was *l* 13 4 8 due on the second for interest, he paid off 24 Moydores, 2 Guineas and 6*s.* 8*d.* more, took up the old Bond, and signed a new one still for the Residue. The Principal again ran on till there was *l.*9 11 3, more due, and then he determined to take it up. How much had his Creditor to receive? *Answer*, *l.* 73 1 9.

DIVISION OF DIVERS DENOMINATIONS.

Case I.

TO divide a Number of divers Denominations by a Number less than 12.

Rule.

Divide the highest Denomination by the Divisor: then multiply the Remainder (if any) by that Number which Unity or one of the same Denomination contains of the next lower, and to the Product add the Number of the lower Denomination in the given Dividend; which Sum divide by the given Divisor, and the Quotient is the Number of the lower Denomination; in like Manner proceed from Denomination to Denomination till the lowest be come to.

Application.

		l.	*s.*	*d.*		
1.	Divide	2	13	6	by	2
2.	——	1	17	9	by	3
3.	——	3	18	0	by	4
4.	——	54	17	6	by	5
5.	——	236	10	0	by	6

		l.	*s.*	*d.*		
6.	Div.	1	19	$2\frac{1}{4}$	by	7
7.	—	27	18	6	by	8
8.	—	32	14	0	by	9
		C.	*qrs.*	*lb.*		
9.	—	10	3	16	by	10
10.		17*Yds.*	0*qrs.*	3*na.*	by	11
		l.	*s.*	*d.*		
11	—	182	16	0	by	12

Case II.

To divide by a Composite Number greater than 12.

Rule.

Divide first by one component Part, and the Quotient by the other, the last Quotient is the Answer sought.

Application.

Let *l.*102 14 6, be given to be divided by 21.

		l.	*s.*	*d.*	
21	7)	102	14	6	divided by 7
	3)	14	13	6	the first Quotient to be divided by 3
Answer,		4	17	10	

The Reason is evident.

		l.	*s.*	*d*			*l.*	*s.*	*d.*
12.	Divide	29	15	0	by 21	*Ans.*	1	8	4
13.	——	27	16	0	by 32	—	0	17	$4\frac{1}{2}$
14.	——	67	9	4	by 44	—	1	10	8
15.	——	269	12	4	by 56	—	4	16	$3\frac{1}{2}$
16.	——	248	10	8	by 64	—	3	17	8
17.	——	202	13	6	by 121	—	1	13	6
18.	——	65	14	0	by 72	—	0	18	3
19.	——	34	04	0	by 144	—	0	4	9

Case III.

If the Divisor falls under neither of the foregoing Cases the Quotient may be found by *Long Division* as follows, *viz.*

Divisor 23) 42 19 $7\frac{1}{2}$ (1 17 $4\frac{1}{2}$
23

Remainder 19*l.*
Multiply by 20 Shillings in a 1*l.* and add in 19*s.*

23) 399 (17 Shillings.
23

169
161

Remain 8 Shillings,
Multiply by 12 the Pence in a Shilling and add 7*d.*

23) 103 (4 Pence,
92

Remain 11
Multiply by 4 Farthings in 1 Penny, and add $\frac{1}{2}$,

23) 46 (2 Farthings.
46

		l.	*s.*	*d.*		*l.*	*s.*	*d.*
20.	Divide	113	13	4 by 31	*Answer*,	3	13	4
21.	———	38	17	5½ by 47	———	0	16	6½
22.	———	132	0	8 by 68	———	1	18	10
23.	———	85	6	3 by 75	———	1	2	9
24.	———	740	16	8 by 100	———	7	8	2

† *Case* IV.

If the given Quantity or Divisor consists of ¼, ½, or ¾:

Rule.

Multiply the given Quantity by 4, adding to the Product 1 for ¼, 2 for ½, 3 for ¾; and it will give the Divisor, which divide with as before, and the Quotient multiply by 4, will give the *Answer*.

Examples.

Suppose I give for 6¼ Yards of Cambrick *l.*4 10 7½ at what Rate did I buy it *per* Yard?

```
Yds.
 6¼        l.  s.  d.
 4    { 5) 4  10  7½
 —    {    ———————————
 25   { 5) 0  18  1½
           ———————————
           0   3  7½
                  4
           ———————————
          l.0  14  6 Answer,
```

25. Suppose a Person in Trade to clear *l.*1035 9 0¾ in 10½ Years equally what was his yearly Increase of Fortune? *Answer*, *l.*98 12 3½.

26. Suppose another to clear *l.*518 8 0¼, equally in 8¾ Years, what was his yearly Profit? *Answ.* *l.*59 4 11.

QUESTIONS.

SHEWING THE USE OF THIS DIVISION.

Quest. 1. A Piece of Broad-cloth, containing 24 Yards, cost *l.*18 6 what did it cost *per* Yard? *Ans.* 15*s.* 3*d.*

2. Bought 39*C*, of Butter for *l.*49 14 6, What did it cost *per* Cwt.? *Answer*, *l.*1 5 6.

3. If a Hogshead of Wine cost *l.*16 16, What was it *per* Gallon? *Answer*, 5*s.* 4*d.*

4. If 27*C.* of Sugar cost *l.* 47 13 9, What cost 1*C.*?
Answer, *l.* 1 15 $3\frac{2}{4}$ $\frac{5}{9}$.

5. If a *Cwt.* of Sugar cost 3*l.* 10*s.* What is it *per* lb?
Answer, $7\frac{1}{2}$*d.*

6. If I hold 120 Acres of Land, and my yearly Rent is 87*l.* What do I pay an Acre? *Ansr.* 14*s.* 6*d.*

7. If a Reckoning of *l.* 6 14 2 be to be paid by 35 Persons: What must they pay a-piece? *Ansr.* 3*s.* 10*d.*

8. A Man dying left his estate worth 1000*l.* betwixt his Wife and 3 Sons, *viz.* to his Wife $\frac{1}{3}$; to the eldest Son $\frac{1}{4}$, and the Remainder to the second and third, Share and Share alike: What is the Share of each?

Answer, The Wife *l.* 333 6 8. The first Son 250*l.* The second and third Sons *l.* 208 6 8 each.

9. Three Merchants, A, B and C have a Ship in Company; A hath $\frac{5}{8}$, B $\frac{1}{4}$, and C $\frac{1}{8}$; and they receive Freight *l.* 228 16 8. It is required to divide it among the Owners according to their respective Shares?

Answer, A's Share *l.* 143 0 $5\frac{1}{4}$; B's *l.* 57 4 2; and C's *l.* 28 12 1.

10 Four Merchants have a Ship in Company, *viz.* A hath $\frac{11}{32}$, B $\frac{1}{4}$, C $\frac{7}{32}$, and D $\frac{6}{32}$, and they let it out a Voyage to the *West-Indies* on Freight, at *l.* 22 10 8, *per* Month; she performs the Voyage in 18 Months: what is each Man's Share of the Freight?

Answer, A's *l.* 139 8 6; B's *l.* 101 8; C's *l.* 88 14 6; D's *l.* 76 1.

11. A Father left among 5 Sons an Estate, consisting of 500*l.* in Cash, with 5 Bills, each *l.* 48 10 6, he ordered 20*l.* to be laid out on his Funeral, and his Debts to be paid amounting to 164*l.* the rest he leaves among his Sons, thus To the eldest $\frac{1}{3}$, and to the other 4, equal Shares: What is the Share of each Son?

Answ. *l.* 186 4 2 the eldest, and the others *l.* 93 2 1 a-piece.

12. A Privateer having taken a Prize worth 1025*l.* it is divided into 100 Shares, of which the Captain is to have 11; 2 Lieutenants, each 5; 12 Midshipmen, each 2; and the Remainder is to be divided equally among the Sailors who are 120 in Number?

Answer,

Answ. Captain's Share 112*l.* 15*s.*; Lieutenant's 51*l.* 5*s.*; a Midshipman's 20*l.* 10*s.*; and a Sailor's *l.*4 13 11½.

† 13. Ten Pounds a Quarter is allowed to five Auditors of a Fire-Office. They attend about seven times in the Quarter, and the Absentees' Money is always divided equally among such as do attend. *A* and *B* on these Occasions never miss; *C* and *D* are twice in a Quarter absent, and *E* only once: At the Payment, what had each Man to receive?

CHAP. VI.

REDUCTION.

REDUCTION is the changing a Number of a higher or greater Denomination to a lesser; likewise a Number of divers Denominations to the lowest of them, and the contrary, *viz.* to change a Number of a lesser Denomination to a greater.

I.

To bring a Number of a higher or greater Denomination to a lower or less.

Rule.

Multiply the given Number of the higher by that Number which one of the greater contains of the less.

So 27*l.* will be reduced into	
540 Shillings; for if 27 be mul-	*l.*
tiplied by 20 (the Shillings in	27
a Pound) the Product is 540:	20 Shillings=1*l.*
In like Manner 540 Shillings	——
may be reduced into 6480	540 Shillings
Pence: for if 540 be multi-	12 Pence=1 Shilling.
plied by 12 (the Pence in 1	——
Shilling) the Product is 6480.	6480

II.

II.

To bring a Number of divers Denominations to the lowest mentioned.

Rule.

To the Product found (*per* last) still add the odd Number of the same Denomination.

Application.

So 364*l.* 15*s.* 5*d.* may be reduced into 87545 Pence. thus: 364*l.* multiplied by 20 (because 20 Shillings make 1 Pound), makes 7280 to which, adding 15*s.* the Sum is 7295 Shillings; which Shillings, being multiplied by 12 (the Pence contained in 1 Shilling) produce 87540 Pence, to which add the 5 odd Pence, the Sum is 87545 Pence.

	l.	*s.*	*d.*
	364	15	5
Mult. by	20	Shill. in 1*l.* and add 15*s.*	
	7295	Shill. in 364*l.* 15*s.*	
Mult. by	12	Pence in 1*s.* and add 5*d.*	
	87545	Pence in 364*l.* 15*s.* 5*d.*	

Note. The Practical Method of reducing the Pounds is thus; say 0 is nothing, but 5 is 5, (the Units of the Shillings) then say twice 4 is 8, and 1 (the 10 Shillings in 15) is 9, &c.

III.

To bring a Number of a lesser Denomination to a greater.

Rule.

Divide the given Number by that which one of the greater contains of the less; the Quotient is the Answer.

Application.

	s.
2|0)	54|0
Answ.	27*l.*

So 540 Shillings may be reduced to 27*l.* For, if I divide 540 by 20, (the Shillings in 1 Pound) the Quotient will be 27.

Note.

Note. If after Division any thing remains, the Remainder is of the same Name or Denomination with the Dividend. For it is the remaining Part of the Dividend after the Divisor is taken away as often as possible.

Examples.

In 87545 Pence how many Pounds?

First. I divide 87545 Pence by 12, (because 12 Pence make a Shilling) and thereby get the Quotient 7295 Shills. and there remain 5 odd Pence over: Again, dividing 7295 Shills. by 20, the Quotient is 364*l.* and 15 remain, *viz.* 15 odd Shillings. So 87545 Pence are reduced to 364*l.* 15*s.* 5*d.*

12) 87545

2|0) 729|5 5*d.* rem.

364*l.* 15*s.* 5*d.*

Note. The bringing a greater Name to a lesser is called *Reduction descending*, and bringing a less to a greater *Reduction ascending.*

Reduction descending and ascending mutually prove each other, as may appear by comparing the preceding Operation.

Questions *concerning* Reduction.

Q. What is *Reduction?*

A. The bringing of a greater Denomination to a lesser, called *Reduction descending*; or a less to a greater, called *Reduction ascending.*

Q. How is *Reduction* performed?

A. The Greater to the Less is brought, when I have multiply'd;
But to the Greater to reduce the Less, I must divide.

Q. If there is a Remainder after I divide?

A. The Remainder is of the same Name with the Dividend.

Q. How is *Reduction* proved?

A. *Reduction descending* and *Reduction ascending* prove each other.

1. *Money.*

1. In 36*l.* how many Shillings?

2. In 720 Shillings, how many Pounds?

3. In 357*l.* how many Pence?

4. In 85680 Pence what Pounds?

5. In 476*l.* how many Farthings?

6. In 456960 Farthings how many Pounds?

7. In 49*l.* 18*s.* how many Shillings?

8 In 998 Shillings how many Pounds?

9. In 36*l.* 7*s.* 9*d.* how many Pence?

10. In 8733 Pence what Pounds?

11. In 375*l.* 17*s.* 10¾*d.* how many Farthings?

12. In 360859 Farthings how many Pounds?

13. In 48*l.* 17*s.* 11½*d.* how many Halfpence?

14. In 23471 Halfpence how many Pounds?

2. *Troy-Weight.*

15. In 354lb how many Grains?

16. In 2039040 Grains of Silver how many lb?

17. In 7lb 2*oz.* 15*dwt.* how many Penny-weight?

18. In 1735 *dwts.* how many lb?

19 In 482lb 7*oz.* 13*dwt.* how many Grains?

20. In 2779992 Grains how many lb?

3. *Avoirdupoise-Weight.*

21. In 27*C.* 2*qrs.* 12lb how many Pounds?

22. In 3092 Pounds how many Hundred-weight?

23. In 24 *Ton*, 14*C.* 3*qrs.* 15lb how many Pounds?

24. In 55427 Pounds how many Tons?

25 In 18lb 10*oz.* 8*drs.* how many Drams?

26. In 4776 Drams how many Pounds?

27. In 24 *Ton*, 17*C.* 3*qrs.* 17lb 5*oz.* 14*dr.* how many Drams?

28. In 14275934 Drams how many Tons?

Note, Since 112 Pounds make 1 C. Weight, Hundred-weights may be brought into Pounds by multiplying them by 112; and contrarywise, Pounds may be reduced into Hundred-weights by dividing them by 112.

Examples.

Examples.

C.
Reduce 42 into Pounds
112 lb 1 *Cwt.*

```
   84
  42
 42
 ----
 4704 lb.
```

Note, If there be odd Quarters and Pounds, for 1 *qr.* put 28lb, for 2 *qrs.* 56 lb, and 3 *qrs.* 84 lb; which with the odd Pounds add together with the Products placing them Units under Units, &c.

```
       C.  qr.  lb
Bring  27   1   24
Pounds 112
       ---
        54
       27
     27|28 for 1qr.
        24 odd Pounds
       ---
Answ. 3076 Pounds.
```

Bring 4704 Pounds into Hundred-weights?

```
        lb
 112) 4704 (42 C. Answ.
      448
      ---
       224
       224
       ---
```

Note, If a Remainder results after Division, the Remainder is Pounds (131) divide the Remainder by 28, the Quotient will be Quarters, and the last Remainder (if any) Pounds.

Bring 3076 Pounds into Hundred-weights?

```
        C.   C.  qr.  lb
 112) 3076 (27   1   24
      224
      ---
       836
       784
       ---
   28) 52 (1
       28
       --
       24
```

Now it is shewn that any Number being added to itself, the Sum will be equal to the same Number multiplied by 2, and the other Figures of 112 being 1, a Number is multiplied by 112 when put down four Times *viz.* Under itself Units under Units; again, Units in the second Place; and again, Units in the third Place, and then these Numbers collected into one Sum.

Hence

Hence it may be easily conceived how any Number of Hundreds, Quarters and Pounds may readily be reduced into Pounds by *Addition* only, as follows:

Let it be required to reduce 7*C.* 3*qrs.* 12lb into Pounds:

		C.
I put 7 under it-	7 3 12	7 } = 7 × 2
self, which when	7	7 }
added will be equal	7	7. mult. by 10
to the Product of 7	784	7.. mult. by 100
multiplied by 2, then	12	——— ———
7 placed twice more	———	784 mult. by 112
as in the Margin, is	880 lb	84 lb = to 3*qr.*
equal to 7 multiplied	———	12 odd Pounds.
by 10 and 100 respec-		——— C qr. lb
tively.		880 lb in 7 3 12

Examples.

29. In 124*C.* 1*qr.* 13lb how many Pounds? *Answ.* 13929.

30. In 275*C.* 3*qrs.* 27lb how many Pounds? *Answ.* 30911.

31. In 75*C.* 2*qrs.* 27lb how many Pounds? *Answ.* 8483.

32. In 72*C.* 1*qr.* 8lb how many Pounds? *Answ.* 8100.

---

4. *Cloth Measure.*

33. In 75 Yds. 1*qr.* 3 Na. how many Nails?

34. In 1207 Nails, how many Yards?

35. In 720 Yards, how many Ells *English*?

36. In 576 Ells how many Yards?

---

5. *Liquid Measure.*

37. In 65 Tun 2 Hhds. 7 Gal. how many Gallons?

38. In 16513 Gallons, how many Tuns?

39. In 27 Tuns, 3 Hhds. 53 Gallons, 5 Pints, how many Pints?

40. In 56373 Pints, how many Tuns?

QUESTIONS TO EXERCISE REDUCTION.

Quest. 1. In 3400*l.* how many Crowns, Half-crowns, Shillings, Groats and Three-pences, and of each an equal Number? *Answ.* 7004, and 68 Half-Pence over.

2. In 12 Bags of Wheat, each $2\frac{1}{2}$*C.* How many Stone, and allowing 20 Stone to the Barrel, how many Barrels? *Answer*, 240 Stone, and 12 Barrels.

3. How many Strokes doth a regular Clock ſtrike in a Year? *Answer*, 56940.

4. Hew many minutes ſince the Commencement of the Chriſtian Æra, allowing it to be 1797 Years?

5. If from *Dublin* to *Cork* be 101 Miles, I demand how many Barley Corns will reach between the two Places, allowing 3 Barley Corns to make 1 Inch? *Anſ.* 24433920.

6. How often will a Chariot Wheel 18 Feet 4 Inches in Circumference, turn round in running from *Dublin* to *Drogheda*, ſuppoſing the Diſtance 22 Miles? *Anſw.* 8064 Times.

7. Admit a Ship's Cargo from *Bourdeaux* to be 250 Pipes, 130 Hogſheads, and 150 Quarter Caſks, [$\frac{1}{2}$ Hogſheads] how many Gallons in all: And allowing every Pint to be a Pound, what Burden was the Ship of?
Anſwer, 44415 Gallons, and the Ship's Burden was 158 Tuns, 12*C.* 2*qrs.*

8. Suppoſe a Merchant hath Orders to ſhip 892*C.* 3*qrs.* 12lb of Beef in Barrels, each to contain 200lb: How many Barrels will he want? *Anſwer*, 500.

9. Sold 5 Packs of Wool, *viz.*

No.

	C.	qrs.	lb
No 1	5	1	17
2	5	3	14
3	6	2	04
4	4	3	25
5	6	1	12

I want to know how many Stones are therein?

Answer, 204 Stone.

10. How many Boxes, each to hold 12lb, may be filled out of a Hogshead of Tobacco containing $7\frac{1}{2}$*C.*? *Ans.* 70.

11. Received from *Jamaica* 56 Hogsheads of Sugar, each 12*C.* 1*qr.* 10lb (100lb being their *C.wt.*) how many *Cwt.* here of 112lb? *Answer*, 617*C.* 2*qrs.*

12. Imported from *Rotterdam* 46 Bales of Cloth, each containing 24 Pieces, and each Piece 42 Ells *Flemish*; how many Yards were therein? *Answer*, 34776 Yards.

13. In 150000 Crusadoes, each 400 Reas, 1000 Reas to a Milrea of 5*s.* 6*d.*; how many Pounds Sterling?

Answer, 16500*l.*

14. In 506*l.* 12*s.* 6*d.* how many *Portugal* Reas at 20 for 3*d.*? *Answer*, 810600.

CHAP. VII.

THE RULE OF THREE DIRECT.

THE Method of finding a fourth Proportional, from three Numbers given, is called by some the *Rule of Proportion*; by others the *Rule of Three*, because three Numbers are given to find a fourth; and again, the *Golden Rule* for its extraordinary Use.

In Practical Questions wherein three [applicate] Numbers are given to find a fourth Proportional; the greatest Difficulty will be in stating the Question, or abstracting the Numbers out of the Words in the Question, and placing them down in their proper Order.

Now

Now two of the three given Terms are homogenial, or of the ſame Kind, one of which * aſks or moves the Queſtion, and is to be put in the third Place, the other Number of the ſame Kind in the firſt; and the remaining Number in the ſecond, being of the ſame Name or Kind with the fourth required. For Inſtance,

If 3 Yards coſt 9 Shillings, what will 6 Yards coſt at the ſame Rate or Proportion?

Here the firſt Clauſe, [If 3 Yards coſt 9 Shillings] aſſigns, or ſuppoſes the Rate; then follows the Queſtion, what will 6 Yards coſt? Conſequently the Numbers muſt be ranged thus, by the Rule, *viz.*

Yds.	*Shil.*	*Yds.*		
3 ——	9 ——	6	6 Yds. which moves the Queſtion —	3d.
			3 Yards the ſame Kind — —	1ſt.
			9 Shillings — —	2d.

The Numbers being thus ſtated, the Rule for the Operation is as follows:

Rule for the Operation.

Multiply the ſecond and third Terms, and divide their Product by the firſt: The Quotient is the fourth Proportional ſought of the ſame Name and Kind with the ſecond.

```
Yds.      s.      Yds.
3 ——————— 9 ——————— 6
          6
        ———
     3) 54 Prod. 2 and 3
        ———
        18 Shillings.
```

If the firſt Number be 1, the Anſwer or fourth is found by multiplying the ſecond and third: And if the ſecond or third be 1, the fourth will be found by dividing the other Number by the firſt.

To

* *Aſks or moves the Queſtion.*] The Term which moves the Queſtion hath generally ſome Words like theſe before it, *viz.* What will? What coſt? How many? How far? How long? or How much?

To prove the Work. Multiply the first and fourth Terms together; likewise the second and third: And if the Products be equal the Work is right.

	1st.	Proof.	
4th . .	18	9 . .	2d.
1st . .	3	6 . .	3d.
	54	54	

Otherwise by varying the stating, as follows:

1. Directly (*per* Qu.) 3 : 9 : : 6 : 18

2. Inversely. 9 : 3 : : 18 : 6

Or 2. Inversely. 18 : 6 : : 9 : 3

```
         9 : 3
         6
      -----
  18) 54 (3
      54
      -----
```

3. Alternately 3 : 6 : : 9 : 18

```
      9 : 18
      6
   -----
 3) 54
   -----
    18
```

That is when the fourth Number is found, if it be made the first of another Stating, the third given Number the second; the second the third; and we work by the general Rule if the Answer be the first given Number, the work is right, or otherwise.

These Things being premised, I intend to lead the Learner gradually through the Varieties of this excellent Rule, in the sundry Cases following:

Case I. *Rule.*

The fourth Number is always found in the same Name which the second is given in, or reduced to; which if it be not the highest Denomination of its Kind, reduce it to the highest when it can be done.

Application and Reason.

Let the following Question be proposed, *viz.* If 1lb of Sugar cost 7*d.* what will 112lb come to?

Multiplying the third 112 by 7 the second, I find the Product 784, which is the fourth Number sought, since the first Number is one, I say it is 784 Pence, the same Name with the second Number, as is self-evident (I think) from the least Consideration of the Nature of the Question: for

for if 1 lb. is equivalent to 7*d.* 112lb. of the ſame muſt be worth 112 times as much *viz.* 112 times 7*d.* *viz.* 784 Pence. But then ſince Accompts are kept in pounds, Shillings and Pence, and Payments made in Coins which are calculated in Shillings and Pence, or Pounds, Shillings and Pence, it is proper that

lb	*d.*	lb
1 ——	7 ——	112
		7
		12) 784
		2|0) 6|5 4
		Anſw. 3*l.* 5*s.* 4*d.*

theſe Pence be brought into Pounds by *Reduction*, and then the Anſwer will be 3*l.* 5*s.* 4*d.* *Q. E. I.*

Examples.

Queſt. 1. What coſt 327 Yards of Canvaſs, at 8*d.* *per* Yard? *Anſwer*, 10*l.* 18*s.*

2. What will 17 Tons of Tallow come to, at 25*l.* the Ton? *Anſwer*, 425*l.*

3. At 7*s.* *per* lb, what coſt 128lb of Tea? *Anſwer*, 44*l.* 16*s.*

4. What coſt 139 Barrels of Barley, at 6*s.* *per* Barrel? *Anſwer*, 41*l* 14*s.*

5. How much is the Price of 178lb of Merchandiſe, at 17*d.* *per* lb? *Anſw.* *l.* 12 12 2.

6. What coſt 1727lb of Rice, at 9 Farthings *per* lb? *Anſwer*, *l.* 16 3 9¾.

Caſe II.

When the ſecond Number is of divers Denominations, bring it to the loweſt mentioned, and the fourth will be found in the ſame Name, to which the ſecond is reduced, which reduce back to the higheſt poſſible.

Examples.

Let it be required to find what 178 Yards of Linen will coſt, at 4*s.* 8*d.* *per* Yard?

1—4 8

```
          s.  d.
1 ———————— 4  8 ———————— 178
          12              56
        ————            ————
          56             1068
                          890
                         ————
                     12)9968
                      ————————
                     2|0)83|0  8
                      ————————
                     £.41  10  8
                      ————————
```

8. What is the Amount of 324 Pieces, at 2*s.* 8½*d. per* Piece? *Answer*, *l.* 43 17 6.

9. How much will 120*C.* come to, at 18*s.* 6*d. per Cwt.*? *Answer*, 111*l.*

10. What will 24 Yards of Broad-cloth cost, at 15*s.* 3*d. per* Yard? *Answer*, 18*l.* 6*s.*

11. Bought 39*C.* of Butter, at *l.* 1 5 6, *per Cwt.* what comes it to? *Answ.* *l.* 49 14 6.

12. If I hold 120 Acres of Land, at 14*s.* 6*d. per* Acre, what is my yearly Rent? *Answ.* 87*l.*

13. If I expend one Week with another, *l.* 2 13 5½, *per* Week, what is my Expence in 52 Weeks? *Answer*, *l.* 138 19 10.

Case III.

If the first and third be of different Names, or one or both of divers Denominations, reduce them both to one Denomination, that is, to the lowest mentioned in either.

14. What Quantity of Brandy can I get for *l.* 18 18, at 6*s. per* Gallon? *Answer*, 1 Hogshead.

15. At

14. At 5*s.* *per* Ounce, what Silver will 6*l.* pay for?
Answer, 2 lb.

15. If a Yard of Broad cloth cost 12*s*, how many Yards can I have for 15*l.*? *Answer*, 25 Yards.

16. If one ounce of Spice cost 4*d.* what is the Price of 112 lb? *Answer*, 29*l.* 17*s.* 4*d.*

17. At 3*s* 4*d.* *per* Pair, what cost 17 Dozen and 4 pair of Stockings? *Answer*, 34*l.* 13*s.* 4*d.*

18. If 1 Ton of Cheese cost 16*l.* 16*s.* what cost 20 Ton 17 *C.* 2*qrs.*? *Answer*. 350*l.* 14*s.*

19. If 1 lb of Silk be worth 1*l.* 9*s.* 6*d.* what cost 25 lb 8oz.? *Answer*, *l.*37 12 3.

20. If 1*C.* of Sugar cost *l.*1 6 8 what cost 17*C.* 2*qrs.* 14*lb.*? *Answer*, *l.*23 10.

21. At *l.*16 16 *per* Hogshead, what come 27 Hhds. 9 Gal. to? *Answer*, 456*l.*

22. If *l.*6 4 11$\frac{1}{4}$ be paid for the Carriage of 17*C* 3*qrs.* 11*lb.* what was paid for the Carriage of 1 lb.?
Answer, $\frac{3}{4}$*d.*

23. If 2*C.* 3*qrs.* 21*lb.* of Sugar cost *l.*6 1 8, what cost 35$\frac{1}{4}$*C.*? *Answer*, 73*l.*

24. Bought a Butt of Wine for *l* 62 8 at 5*s.* 4*d.* *per* Gal. How many Gallons did it contain? *Answ.* 234 Gal.

Case IV.

When the Product of the second and third is divided by the first; if there happen a Remainder after the Division is ended, and the Quotient is not the least Denomination of its Kind; then multiply the Remainder by that Number, which one of the same Denomination with the Quotient contains of the next lesser, and divide this Product again by the

first Number; and proceed in the same Manner till the least Denomination be found, or till nothing remain.

Let it be required, If 1 Tun of Cheese cost 16*l.* 16*s.* how much can I buy for *l.* 350 14?

```
 l.  s.        Ton         l.    s.
 16  16 ———— 1 ———— 350   14
 20                  20
 ———                 ———
 336           336) 7014 (20
                     672
                     ———
                     294
                      20
                     ———
               336) 5880 (17
                     336
                     ———
                     2520
                     2352
                     ———
                      168
                        4
                     ———
               336)  672 (2
                     672
                     ———
```

Examples.

25. What Quantity of Wine can I buy for 456*l.* at 16*l.* 16*s. per* Hogshead? *Answer*, 27 Hogsheads, 9 Gal.

26. A Goldsmith sold a Tankard for 10*l.* 12*s.* at 5*s.* 4*d. per oz.* I demand the Weight thereof?
Answer, 39*oz.* 15*dwts.*

27. Bought a Hogshead of Tobacco for 17*l.* 9*s.* which weighed 5*C.* 2*qrs.* 16*lb.* I demand the Price of 4 Hogsheads containing 23*C.* 1*qr.* 3*lb.*? *Answ. l.*71 19 $7\frac{1}{2}$.

28. If

28. If a Butt of Wine containing 234 Gallons cost 62*l.* 8*s.* what was it *per* Gallon? *Answer*, 5*s.* 4*d.*

29. If an Ingot of Silver weigh 36*oz.* 10*dwt.* what is it worth at 5*s. per* Ounce? *Answer*, 9*l.* 2*s.* 6*d.*

30. What will the Carriage of 17*C.* 3*qrs.* 11*lb.* come to at the Rate of 7*s. per* Cwt.? *Answer*, *l.*6 4 11$\frac{1}{4}$.

Note. 1. If the Divisor have a Cypher or Cyphers in its lowest Place or Places, and if the Dividend hath the same Number of Cyphers in the same Places, cut off the Cyphers from both and reject them entirely, and the significant Figures of the Divisor only, will remain the Divisor, from Denomination to Denomination, as for

Example.

31. How much Sugar can I buy for 23*l.* 10*s.* at 1*l.* 6*s.* 8*d. per* C.

Here 320 is the Divisor, and 5640 the Dividend; from both which I reject the Cyphers in Units Place, and divide the significant Figures of the one by those of the other, whereby I procure the true Quotient 17.

```
 l. s. d.        C.        l.  s.
 1  6  8———————1———————23  10
20                      20
——                     ———
26                     470
12                      12
———                    ———
32|0             32|0) 564|0 (17
                        32
                       ———
                       244   C. qrs. lb.
                       244   17  2   14
                       ———
                        20
                         4
                       ———
                   32)  80 (2
                        64
                       ———
                        16, &c.
```

But if the Figures cut off from the Dividend be not all (or any of them) Cyphers, as many as are not must be restored to the Remainder, and the same Number of Cyphers retained in the Divisor; as for

Example.

32. I want to know the Price of 5 Chests of Tea containing 4*C.* 2*qrs.* 14*lb.* when 1 Chest containing 3*qrs.* 6*lb.* cost 18*l.*

```
qrs. lb.   l.   C. qrs. lb.
 3   6—18—4   2   14
28                444
——                 56
90                 14
——               ————
                  518
                   18
                 ————
                 4144
                  518
                 ————
          9|0) 932|4
           l.103   54 Rem,
                   20
                 ————
           9|0 108|0
                 ————
                  12 Shil.
```

Here the Divisor is 90; the Dividend 9324, wherein the Figure cut off is 4, which I restore to the Remainder, which becomes (not 5 but) 54, which being multiplied by 20, the Product 1080 I divide again by 90, retaining as many Cyphers as the Figures restored, or brought down. The *Answer*, 103*l.* 12*s.*

33. Bought for *l.*125 8 4, 9 Pieces of Broad-Cloth at 16*s.* 8*d.* *per* Yard; how many Yards were in them? *Answer*, 150 *Yds.* 2*qrs.*

34. If for 9*l.* I buy a Hogshead of Brandy, how much can I buy for *l* 144 5? *Answ.* 16 *Hhds.* 1 *Gal.* 6 *Pints.*

35. Sold 21*C.* 1*qr.* 20*lb.* of Beef for 8*l.* which being liked, a merchant wants 650*C.* 2*qrs.* 19*lb.* of the same; Quere, the Amount? *Answer*, *l.*242 18 4.

36. What is the Interest of 575*l.* for 1 Year at 5 *per Cent.*? *Answer*, *l.*28 15.

The work of this Question is only the *Application* of *Preposition* 20, and this Rule or Case: And in this Method we calculate all Premiums, Allowances or Rates *per Cent.* or 100, *viz.* The first Number being 100,

```
  l.        l.        l.
100———————5———————575
                    5
               ——————
              l.28|75
                   20
               ——————
              s.15|00
```

37. I demand

37. I demand the Price of 2160 Skains of Worsted, at 23*s per* 100 Skains? *Answer*, *l.*24 16 $9\frac{1}{2}\frac{40}{100}$.

38. What is the Commission on 1024*l.* at 2 *per Cent.*? *Answer*, *l.*20 9 $7\frac{1}{5}$.

39. What is the Exchange between *London* and *Dublin*, on 585*l.* at 7 *per Cent*: *Answer*, *l.*40 19.

Case V.

If the first Number be greater than the Product of the second multiplied by the third; then bring the second to a lower Denomination.

40. If 17 *Ton* 12*C.* of Iron cost 165*l.* what is that for 2*C.*? *Answer*, 18*s.* 9*d.*

```
  Ton      C.        l.        C.
  17       12 ------ 165 ------ 2
  20                  20
 ----               -----
 352                3300
                       2
                   ------
              352) 6600 (18 9
                   352
                   ----
                   3080
                   2816
                   ----
                    264
                     12
                   ----
                   3168
                   3168
                   ----
```

41. If 27 Hogsheads of Brandy cost 456*l.* what is that *per* Gallon? *Answer*, 5*s.* $4\frac{1}{4}d.\frac{603}{1701}$.

42. If *l.*16 16 6 pay for 18*C.* 0*qrs.* 3*lb.* of Cheese; how much can I buy for 1*s.*? *Answer*, 6lb.

43. If 16 Gallons cost *l.*2 8 what cost 1 Quart? *Answer*, 9*d.*

44. If 153*C.* 0*qrs.* 16*lb.* cost 536*l.* what cost 14lb? *Answer*, 8*s.* 9*d.*

45. If a Man's yearly Income be 300*l.* what is that *per* Day? *Answer*, 16*s.* $5\frac{1}{4}d.\frac{15}{365}$.

Case VI.

When any Number of Barrels, Bales, or other Packages or Pieces are given, each containing an equal Quantity, let the Content of one reduced to the lowest Name, be multiplied by the given Number of Packages, or Pieces.

Application and Reason.

46. Bought 4 Pieces of Cloth, each 12 Ells, for *l.*7 10 what cost 1 Ell?

4 Pieces, each 12 Ells.
4
48 Ells in all.

	Ells	*l.*	*s.*		*Ell.*
If	48 cost	7	10	what	1
		20			
			s.	*d.*	
	48)	150 (	3	$1\frac{1}{2}$	

47. If an Ounce of Silver be worth 5*s.* what is the Price of 14 Ingots, Each Ingot 7*lb.* 5*oz.*? *Answ.* *l.*311 10.

48. Bought 6 Hogsheads of Sugar, each 6*C.* 3*qrs.* at 56*s.* *per C.* what come they to? *Answer*, *l.*113 8.

49. Bought 14 Bags of Hops, each 4*C.* 3*qrs.* 14*lb.* for 237 Guineas; what do they stand me in *per Cwt.*? *Answer*, *l.*3 19.

50. If 10 Pieces of Cloth, every Piece 42 Yards cost 126*l.* what will one Yard cost? *Answer*, 6*s.*

Case

Case VII.

If the given Pieces, Barrels, Bales, *&c.* be of unequal Contents (as it most generally happens) put the separate Contents of each orderly under each other, and add them into one Sum, whereby we obtain the whole Quantity.

Application.

51. Bought 3 Hogsheads of Brandy, containing 61, 62, 62½ Gallons, at 6*s.* 8*d.* *per* Gallon. I demand how much they amount to?

					Gal.
					61
					62
					62½
	Gal.	*s.*	*d.*		
If	1 cost	6	8	what	185½
	2	12			2
	2	80			371
					80
					2) 29680
					12) 14840
					2|0) 123|6 8
				Answer,	£ 61 16 8

52. Bought 3 Pipes of Wine containing 120½, 124, 126¾ Gallons, at 5*s.* 6*d.* *per* Gallon: what come they to?
Answer, *l.* 102 1 10½.

53. What is the Price of 4 Pieces of Cloth containing 23, 24, 25 and 27 Yards, at 5*s.* 5*d.* *per* Yard?
Answer, *l.* 26 16 3.

54. Bought 4 Parcels of Butter, the first Weight 10*C.* 3*qrs.* 27*lb.*; the second 13*C.* 0*qrs.* 1*lb.*; the third 23*C.* 2*qrs.* 0*lb.*; the fourth 19*C.* 3*qrs.* 14*lb.* at 16*s.* 8*d.* the Cwt. what do they amount to? *Answ.* *l.* 56 2 11.

 55. Sold

55. Sold 4 Hogsheads of Tobacco, No. 1. Weight 5*C.* 2*qrs.*; No. 2, 5*C.* 1*qr.* 14*lb.*; No. 3, 5*C.* 0*qr.* 7*lb.*; No. 4. 5*C.* 1*qr.* 21*lb*, at 10½*d.* *per* lb. I demand the Amount? *Answer*, *l.*104 14 9.

56. Bought 4 Bags of Wool containing, No 1, 4*C.* 3*qrs.* 15*lb.*; No. 2. 5*C.* 2*qrs.* 12*lb.*; No. 3, 7*C.* 2*qrs.* 5*lb.*; No. 4, 6*C.* 1*qr.* 10*lb.* at 10*s.* 8*d.* *per* Stone. How many Guineas will pay for them? *Answer*, 80 Guineas.

When the foregoing Cases are well understood, the Learner will be able to solve [it is hoped] the most common Questions in this Rule; I will now proceed to shew how to shorten the Work in some particular Cases.

CONTRACTIONS IN THE RULE OF THREE.

Case I.

When the first and third Numbers are such as fall under the Cases of *Multiplication* and *Division of Divers Denominations*, and the second is of divers Denominations; Then if we multiply and divide as is there taught, it will shorten the Work by saving the Trouble of Reduction in form. As for

Example.

57. If 14 Ton of Tallow cost *l.*338 6 8 what cost 17 Ton;

	Ton	*l.*	*s.*	*d.*		*Ton.*	
	14	338	6	8		17	
				4			
		1353	6	8	16		*Per Mult.* of divers Denominations.
				4			*Case* 3.
		5413	6	8			
		338	6	8	1		
Per Divis. 14 *Case* 2.	2)	5751	13	4	17		
	7)	2875	16	8			
Answer, £.		410	16	8			

58. If

58. If the Freight of a Ship amount to *l.*124 17 6. what must I receive for my $\frac{5}{32}$ Parts? *Answ. l.*19 10 $2\frac{3}{4}$.

59. If a Captain's Pay for 3 Weeks be *l.*6 17 6. What is his Yearly pay? *Answ. l.*119 3 4.

60. At 18*s.* 8*d.* *per* Cwt. what cost a Parcel containing 34lb? *Answer*, 5*s.* 8*d.*

61. If a Hogshead of Brandy cost *l.*16 16 what must I give for 5 Gallons? *Answ. l.*1 6 8.

Case II.

When the first Term is an aliquot Part of the second or third; divide by the first that of which it is an aliquot Part, and multiply the other by the Quotient.

If 27lb of Chocolate cost *l.*6 15, what is that *per* Cwt.

lb.	*l.* *s.*		lb.
27 ——	6 15	——	112
	20		5
27)	135 (5	2|0)	56|0
	135	*Answ.*	28*l.*

62. What is the Price of 12 *Tun* 4*C.* of Iron, when 5*C.* cost *l.*3 10.? *Answer*, *l.*170 16

63. At *l.*36 10. *per Annum*; what is that *per* Week? *Answer*, 14*s.* $0\frac{1}{4}$*d.* $\frac{44}{52}$.

64. If 12 *Ton* of Brandy cost 1296*l.* what cost 19 *Ton*? *Answer*, 2052*l.*

65. If 9 Gallons of Rum cost *l.*2 4 10, what is that *per* Hogshead? *Answer*, *l.*15 13 10.

66. If 14*lb.* of Sugar cost 13*s.* at what Rate is that *per* Cwt.? *Answer*, *l.*5 4.

67. If 25*lb.* cost *l.*2 6 8, what is that for 100*lb.*? *Answer*, *l.*9 6 8.

68. If 13*l.* gain *l.*1 15. what will 104*l.* gain at that Rate? *Answer*, 14*l.*

69. If 2 Ounces of Silver be worth 11*s.* 6*d.* what is 1lb. worth? *Answer*, *l.*3 9.

70. At 9*s.* 9*d.* *per* Stone, what cost 1 Cwt. of Wool? *Answer*, *l.*3 8 3.

Case III.

On the contrary, when the second or third is an even Part of the first, divide the first by that which is a Part of it, and by the Quotient divide the other.

71. If *l.*3 10 buy 5 Cwt. what will *l.*64 8 buy? *Answer*, 92 Cwt.

72. If 1296*l.* pay for 12 Ton of Brandy, how much then can I get for 2052*l.*? *Answer*, 19 Ton.

73. If the Price of a Hogshead of Rum be *l.*15 13 10, what must I give for a Cask containing 9 Gallons? *Answer*, *l.*2 4 10.

74. At *l.*5 4 *per* Cwt. what is that *per* Stone? *Answer*, 13*s.*

75. Bought 4 Bags of Wool, weighing in all 28*C.* 3*qrs.* 14*lb.* I want to know the Trett of said Wool, being 8lb. for every 3 Cwt.? *Answer*, 2*qrs.* 21*lb.*

76. If 3 Hogsheads of Brandy cost *l* 68 17, what will 7 Gallons be worth? *Answer*, *l.*2 11.

Case IV.

When the first and second, or the first and third have a common Measure, (*i. e.* when some Number will divide both) divide them by their greatest common Measure, and work with the Quotients instead of the given Numbers.

Application.

Application.

77. If 63 Gallons of Wine cost *l.*16 16. what is the Price of 84 Gallons?

	Gal.	l.	s.		Gal.
21)	63	16	16	21)	84
	—		4		—
	3				4
		3) 67	4		
	Answer,	*l.*22	8		

78. How much Beef can I buy for 100*l.* if 802*C.* 1*qr.* 17*lb.* cost 650*l.*? *Answer,* 123*C.* 1*qr.* 22*lb.*

79. If 1*l.* *English* Money be worth 1*l.* 13*s.* 4*d.* *Flemish*, how many Pounds *Flemish* are in *l.*279 8 *English*?
Answer, *l.*465 13 4.

80. If a chest containing 48 Pound of Tea cost 24*l.* 18*s.* 9*d.* what is it *per* Cwt.? *Answ.* *l.*58 3 9.

81. Sold 3 Hogsheads of Port-Wine containing 240 Gallons for 58*l.* and am to receive ready Money for two of them containing 126 Gallons; what must I receive?
Answer, *l.*30 9

QUESTIONS FOR EXERCISE.

82. What must I pay of 1635*l.* deducting 1 *per Cent* for prompt Payment? *Answer,* *l.*1618 13.

83. Bought 6 Pipes each containing 121 Gallons of Wine, at 4*s.* 9*d.* *per* Gallon, by Auction, and for prompt Payment am allowed 1*s.* in the pound; what must I pay for said Wine, and what am I abated *per Cent.*
Answer, I must pay *l.*163 16 1 and am abated 5 *per Cent.*

84. If I have owing to me 1000*l.* and compound with my Debtor at 12*s.* 6*d.* *per* Pound; how much must I receive? *Answer,* 625*l.*

85. *A* sets

85. *A* sets out from a certain Place and goes 12 Miles a Day, 5 Days after *B* sets out from the same Place, the same Way, and goes 16 Miles a Day; in how many Days will he overtake *A*? *Answer*, 15 Days.

86. If I buy Tallow at 35*l.* *per Ton*, how must I sell a Ton to gain by 10 Ton, as much as one Ton Cost?
Answer, 38*l.* 10*s.*

87. A Goldsmith bought of a Merchant a Wedge of Gold, which weighed 14lb 3*oz.* 8*dwt.* for 514*l.* 4*s.* what did he pay *per* Ounce? *Answer*, 3*l.*

88 A Grocer Bought 3*C.* 1*qr.* 14lb of Cloves at 2*s.* 4*d.* *per* Pound, and sold them for 52*l.* 14*s.* whether did he gain or lose by the Bargain? *Ansr.* He gained 8*l.* 12*s.*

89. A Draper bought of a Merchant 8 Packs of Cloth, each pack had 4 Parcels in it, and each parcel contained 10 Pieces, each Piece 26 Yards; he gave after the Rate of 4*l.* 16*s.* for 6 Yards; what came the 8 Packs to, and what is it worth *per* Yard? *Ansr.* 6656*l.* at 16*s.* *per* Yd.

90. How many Dozen of Stockings at 11 Groats a Pair can I buy for *l.* 190 9 8? *Answ.* 86 Dozen, 7 Pair.

91. If I buy 100 Yards of Ribbon at 2 Yards for a Shilling, and 100 Yards do at 3 Yards for a Shilling, and sell them again for 2 Shillings the 5 Yards, whether do I gain or lose and how much? *Answer*, I lose 3*s.* 4*d.*

92. Bought 45 Barrels of Beef at 21 Shillings *per* Barrel, among which are 16 Barrels, which, being damaged, I take them upon being allowed 4 instead of 3; I demand what must I pay for them? *Answer*, 43*l.* 1*s.*

93. A Merchant bought 5 Ton of Wine for 285*l.* by the Misfortune of a Pipe staving he lost 120 Gallons, but is willing to sell it so as to sustain no Loss; I desire to know how he must sell it *per* Gallon? *Answer*, 5 Shillings.

94. A Gentleman, who hath an Estate of 265*l.* 19*s.* 2*d.* yearly Rent, would regulate his Expense in such a Manner as to lay up 60 Guineas a Year; I desire to know how much he must spend a Day? *Answer*, 10*s.* 10*d.*

95. Imported from *Holland* 84 Pieces of Linen, which cost me 537*l.* 12*s.* at 4*s.* *per* Ell *Flemish*; how many Yards were there in all; in one Piece; and what cost it *per* Yard?
Answer, 2016 Yards in all; 24 Yards in one Piece; at 5*s.* 4*d.* *per* Yard.

96. Two men depart from one Place, the one goes North 7 Miles a Day, the other South 11 Miles a Day; how far are they distant the 12th Day after their Departure?
Answer, 216 Miles.

97. A Merchant would lay out in Spices 560*l.* *viz.* Cloves at 4*s.* *per* lb; Mace at 7*s.*; Cinnamon at 3*s*; and Nutmegs at 2*s.* and he would have an equal Quantity of each Sort, I demand the Quantity? *Answ.* 700lb of each.

98. Shipped for *Jamaica* 550 Pair of Silk Stockings, at 11*s.* 6*d.* *per* Pair, and 460 Yards of Stuff at 14*d.* *per* Yard; in Return for which I had 46*C.* 3*qrs.* of Sugar at 24*s.* 6*d.* *per* Cwt. and 1570lb of Indigo, at 2*s.* 4*d.* *per* lb; what remains due to me of my Adventure?
Answer, *l.* 102 12 11½.

99. A Factor bought a certain Quantity of Broad-cloth and Drugget, which together cost 81*l*; the Quantity of Broad-cloth was 50 Yards at 18*s.* *per* Yard; and for every 5 Yards of Broad cloth he had 9 Yards of Drugget: I demand how many Yards of Drugget he had, and what it cost him *per* Yard? *Answer*, 90 Yards, at 8*s.* *per* Yard.

100. A Merchant shipped for *Spain* 400 Cloths, which produced neat 12*l.* *sterl.* *per* Cloth, and is willing to have Returns, one half in Wine at 30*l* *per* Ton, and the other half in Rice, at 28*s* *per* Cwt. I demand how much of each Sort must be returned for the Cloths?
Answer, 80 Ton of Wine, and 1714*C.* 1*qr.* 04lb of Rice.

101. A Debtor who owes several Persons *l* 1490 5 10 compounds, and pays them as far as his Effects will go, which amount to no more than *l.* 931 8 7¾, how much do the Creditors receive *per* Pound? *Answ.* 12*s.* 6*d.*

102. If

102. If 30 Pence and 40 Groats buy 50 Pints of Wine, What is the Cost of 60 Quarts in current Sterling Coin?
Answer, 1*l.* 18*s.*

103. Whereas a Moydore and a Crown just 15 Yards did buy:
How many Ells of that same Cloth for 50*l.* had I?
Answer, $346\frac{64}{713}$.

104. If from a Rule of 3 Foot long, the Shadow 5 is made,
What is the Steeple's Height in Yards, that's 90 Feet in Shade? *Answer*, 18 Yards.

105. If 2lb of Pepper cost 25*d.* what will 60lb of Cloves come to if 3lb of Cloves be worth 16lb of Pepper?
Answer, *l.* 16 13 4.

106. How many dozen of Gloves at 8*d.* the Pair, will pay for 36 Dozen and 8 Pair of Stockings at 3*s.* 6*d.* *per* Pair? *Answer*, $192\frac{1}{2}$ Dozen.

---

† OF SOUND.

Sound not interrupted, is by Experiments found uniformly to move about 1150 Feet in one Second of Time.

107. How long, after firing a Cannon off Carrickfergus, may the Report be heard at Belfast, taking the Distance at 9 Miles? *Answer*, 52 Seconds, $35\frac{11}{23}$ Thirds.

108 If I see the Flash of a Piece of Ordnance, fired by a Vessel in Distress at Sea, which happens we will suppose nearly at the instant of its going off, and hear the Report a Minute and three Seconds afterwards, how far is she off, reckoning for the Passage of Sound as before?
Answer, 10 Miles, $6\frac{1}{4}$ Furlongs.

† OF THE LEVERS.

There being three Orders of Levers, or three Varieties, wherein the Weights, Prop, or moving Powers, may be differently applied to the Vectis, or inflexible Bar, in order to effect mechanical Operations in a convenient Manner.

† For

† *For the First Order, see* Page 100.

Of the Second and Third Order of LEVERS.

In Mechanics, a Lever of the second Order, is where the Power acts at one End, the Prop fixed directly at the other, and the Weight somewhere between them.

In this Order of Levers, their Force is in a *contra* Proportion to their Length.

In a Lever of the third Order, the Prop is planted at one End of the Bar, the Weight at the other End, and the moving Force somewhere between.

109. If a Lever be 100 Inches long, what Weight, lying $7\frac{1}{2}$ Inches from the End, resting on a Pavement, may be moved with the Force of 168lb lifting at the other End of the Lever? *Answer*, 2072lb.

110. A Water-wheel turns a Crank, working three Pump rods, fixed just six Feet from the Joint or Pin; by which their several Levers, each nine Feet in Length, are fastened, for the sake of the intended Motion, at one End the Suckers of the Pumps being wrought by the other, shews them to be Levers of the third Order: Now I wou'd know what the Length of the Stroke in each of the Barrels will be, if the Crank be made to play just nine Inches round its Centre? *Answer*, 27 Inches.

111. With what Force ought that Water wheel to be driven, which, circumstanced as in the last Question, raises 3 cubic Feet of Water at every Revolution of the Wheel, each experimentally weighing $62\frac{1}{2}$lb Avoirdupoise, the Friction of the Machine rejected? *Answ.* $281\frac{1}{4}$lb.

† MOTION OF BODIES, WITH THEIR VELOCITIES.

1. If the Quantities of Matter in any two or more Bodies put in Motion be equal, the Forces wherewith they are moved will be in Proportion to their Velocities.

2. If the Velocities of these Bodies be equal, their Forces will be directly as the Quantities of Matter contained in them.

3. If both the Quantities of Matter, and the Velocities be unequal, the Forces with which the Bodies are moved, will

will be in a Proportion compounded of the Quantities of Matter they contain, and of the Velocities wherewith they move.

112. There are two bodies, the one contains 25 Times the Matter of the other (or twenty-fives Times heavier) but the leſſer moves with 1000 Times the Swiftneſs of the greater; in what Proportion are the Forces by which they are moved? *Anſwer*, leſſer 40 to 1.

113. There are two Bodies, one of which weighs 100lb the other 60lb, but the leſſer Body is impelled by a Force 8 Times greater than the other, the Proportion of the Velocities wherewith theſe Bodies move, is required?

Anſwer, as $13\frac{1}{3}$ to 1.

1. In comparing the Motions of Bodies, if their Velocities be equal, the Spaces deſcribed by them are in direct Proportion of the Times in which they are deſcribed.

2. If the Times be equal, then the Spaces deſcribed will be as their Velocities.

3. If the Times and Velocities be unequal, the Spaces will be in a Proportion compounded of the Times and Velocities.

114. There are two Bodies, one of which moves forty Times ſwifter than the other, but the ſwifter Body has moved but one Minute, whereas the other has been in Motion 2 Hours: The Ratio of the Spaces deſcribed by theſe two Bodies is required?

Anſw. the ſwifter to the ſlower as 1 to 3.

115. Suppoſe one Body to move thirty Times ſwifter than another; as alſo the ſwifter to move 12 Minutes, the other only 1, what Difference will there be between the ſpaces by them deſcribed, ſuppoſing the laſt has moved 60 Inches? *Anſwer*, 1795 Feet.

116. There are two Bodies, one whereof has deſcribed 50 Miles, the other only 5, but the firſt hath moved with 5 times the Velocity of the ſecond; what is the Ratio then of the Times they have been deſcribing thoſe Spaces?

Anſwer, the firſt Body hath been in Motion double the Time of the latter.

QUESTIONS.

QUESTIONS.

Q. What is the *Rule of Three?*

A. That which teaches from three Numbers given to find a fourth Proportional.

Q. How are the given Numbers to be managed?

A. The first and third must be reduced to the same Name, *viz.* the lowest mentioned in either, and the second likewise to its lowest Name.

Q. How must the Numbers be stated?

A. So that the first and third may be of one Name or Kind.

Q. How is the Operation performed?

A. Multiply the second and third together, and divide their Product by the first, the Quotient is the fourth Number sought, in the same Name with the second.

CHAP. VIII.

THE RULE OF THREE INVERSE.

HItherto the Questions proposed were such that the first Number of the Stating was always to the third as the second was to the fourth required, which is called direct Proportion, or the *Rule of Three Direct:* and this is the most useful and general Property of Proportionals, as will appear by the Sequel.

But (the Question being stated according to the Rule before laid down) the Nature and Conditions of several Questions are such, that, as the first is to the third, so reciprocally must the fourth be to the second; That is, the greater the third is in Proportion to the first, the less must the fourth be in respect of the second: Or the less the third is in Proportion to the first, the greater the fourth must be in Proportion to the second. This is called reciprocal or inverted, or indirect Proportion, or *the Rule of Three Inverse.*

The principal Difficulty that will embarrass the Learner will be, to distinguish when the Proportion is direct and when indirect. This is done from an attentive Consideration of the Sense and Tenor of the Question proposed; for if thereby it appears that when the third Term of the Stating

is leſs than the firſt, the Anſwer muſt be leſs than the ſecond, or when the third is greater than the firſt, the Anſwer muſt be greater than the ſecond: then the Proportion is direct.

But if the third is leſs than the firſt, and yet the Senſe of the Queſtion requires the fourth to be greater than the ſecond, or if the third being greater than the firſt, the Anſwer muſt be leſs than the ſecond, the Proportion is indirect.

Application.

Firſt, this Queſtion being propoſed, If 12 Men make 4 Perch of Ditching in one Day, How many Perch will 24 Men make in the ſame Time? The Stating will ſtand thus:

Men	*Perch*	*Men*
12———	4———	24

where it is very manifeſt that 24 Men will do more in the ſame Time than 12 at the ſame Proportion of working, *viz.* in Proportion as 24 to 12, *i. e.* twice as much, *viz.* 8 Perches: So then 24 Men being more than 12, and requiring the Anſwer more than 4 Perches (the ſecond Number) this Queſtion is direct.

But if the Queſtion propoſed were this, *viz.* If 12 Men make 16 Perch of Ditching in 4 Days, in what Time will 24 Men perform the ſame at the ſame Rate of working?

Here 16 is a ſuperfluous Term, having no correſponding Term, which being rejected, ſtate the other Terms of the Queſtion.

Men	*Days*	*Men*
12———	4———	24

In which Stating it is very evident that 24 Men will perform 16 Perch in leſs Time than 12 Men, and that therefore the fourth required muſt be leſs than the ſecond, in the ſame Proportion as the third is greater than the firſt, therefore the Proportion is inverſe or indirect.

Rule for the Operation.

The Queſtion being ſtated as already directed in the *Rule of*

of Three Direct, multiply the first and second Numbers together, and divide the Product by the third, the Quotient is the Answer required, in the same Name with the second.

Men	*Days*	*Men*
12	4	24
	12	

```
24) 48 (2 Days, Answer,
    48
    ——
```

QUESTIONS.

Q. What is the *Rule of Three Inverse?*

A. When three Numbers are given to find a fourth, which shall have such Proportion to the second as the first to the third.

Q. How is a Question distinguished whether it belong to the *Rule of Three Inverse* or *Direct*?

A. If more do more or less do less respect,
It is a Question in the *Rule Direct*;
But less requiring more and greater less,
A Question of the *Inverse Rule* express.

Examples.

Q. 1. There was a certain Building raised in 8 Months by 120 Workmen; but the same being demolished, it is required to be rebuilt in 2 Months: How many men must be employed about it? *Answer*, 480 Men.

2. If 28*s.* will pay for the Carriage of an Hundred weight 150 Miles; how far may 6 Cwt. be carried for the same Money? *Answer*, 25 Miles.

3. If for 5*l.* 5*s.* I have 14 Cwt carried 136 Miles; how many Miles may I have 24 Cwt. carried for the same Money? *Answer*, $79\frac{1}{3}$ Miles.

4. If a Footman perform a Journey in 3 Days, when the days are 16 Hours long, how many Days will he require of 12 Hours long to go the same Journey in?
Answer, 4 Days.

5. How

5. How many Yards of Plush are sufficient to make a Cloak of equal Magnitude with one which hath in it 4 Yds. of 7 Quarters wide, when the Plush is but 3 Quarters wide?
Answer, $9\frac{1}{3}$ Yards of Plush.

6. How many Yards of Canvass that is Ell-wide, will be sufficient to line 20 Yards of Say, that is 3 Quarters wide?
Answer, 12 Yards.

7. If a Man perform a Journey in 6 Days, when the Day is 8 hours long; in what Time will he do it, when the Day is 12 hours long? *Answer*, 4 Days.

8. If I lend my Friend 100*l.* for 6 Months, (allowing the Month to be 30 Days) how long ought he to lend me 1000*l.* to requite my Kindness? *Answ.* 18 Days.

9. If 6 Mowers can mow a Field in 12 Days, in what Time will 24 Mowers do it? *Answ.* 3 Days.

10. Suppose 800 Soldiers were placed in a Garrison, and their Provisions computed sufficient for 2 Months; how many Soldiers must depart that the Provisions may serve them 5 Months? *Answ.* 480 Men.

11. Admit that I lent to a friend on his Occasion *l.*100 for 6 Months, and he promised me the like Kindness when I desired it; but when I came to request it, he could lend me only 75*l.* The Question is, How long I may keep his Money to recompense my courtesy to him?
Answer, 8 Months.

† A LEVER OF THE FIRST ORDER.

A Lever of the First Order hath the Power at one of its Ends, the Weight to be raised is put at the other, and the Fulcrum or Prop somewhere between them.

In this Order, the Power applied at one End will be reciprocally proportional to the Distances of those Ends from the Fulcrum, or Point supported: or in the Steel-yards as the Distance of the Weight from the Point of Suspension.

Examples.

12. What Weight will a Man be able to raise, who presses with the Force of a hundred Weight and an half on

on the End of an equipoised Hand-spike 100 Inches long, which is to meet with a convenient Prop exactly $7\frac{1}{2}$ Inches above the other End of the Machine? *Answ.* $18\frac{1}{2}$ Cwt.

13. What Weight hung at 70 Inches Distance from the Fulcrum of a Steel-yard, will equipose a Hogshead of Tobacco weighing $9\frac{1}{2}$ Cwt. freely suspended at 2 Inches Distance on the contrary Side?

Answer, 30lb, 6 oz. $6\frac{1}{2}$ Drams nearly.

† Motion of Bodies, with their Velocities.

In comparing the Motion of Bodies, the Ratio or Proportion between their Velocities will be compounded of the direct Ratio of the Forces wherewith they are moved, and the reciprocal of their Quantities of Matter they contain.

Examples.

14. The Battering Ram of Vespasian weighed, suppose 100,000lb, and was moved, let us admit, with such a Velocity, by Strength of Hands, as to pass through 20 Feet in one Second of Time, and this was found sufficient to demolish the Walls of Jerusalem; with what Force must a Bullet that weighs about 30lb be moved, in order to do the same Execution?

Answer, 66,666 Feet, 8 Inches *per* Second.

15. A Body weighing 200lb is impelled by such Force, as to send it 100 Feet in a Second; with what Velocity would a Body of 8lb move, if it were impelled by the same Force? *Answer*, 2500 Feet *per* Second.

CHAP. IX.

THE DOUBLE RULE OF THREE.

THIS probably is called the *Double Rule of Three*, because Questions therein may be solved by two Statings of the *Single Rule of Three*. It is likewise by some called the *Rule of Five*, because generally, five Numbers are given to find a Sixth, of which five given Nnmbers, 3 are conjoined in Form of Supposition; and upon that Suppo-

ſition a Queſtion is raiſed of the other two, which with the Number ſought, are reſpectively like the former three.

I. To ſolve Queſtions in this Rule by two Statings of the Single Rule of Three, this is the Rule;

1. Let either of the two Numbers of which the Queſtion is raiſed, be put in the third Place, and the correſpondent Number of the ſame Name or Kind in the firſt, the ſecond will be that which hath no correſpondent Number given.

2. Three of the five given Numbers being thus ſtated, find a fourth Proportional.

3. Put this fourth Number reſulting from the Work of the firſt Stating, for the ſecond Number of a ſecond Stating, the remaining Number of which the Queſtion is raiſed the third, and its correſponding Number of the ſame Name the firſt, and the fourth Number reſulting will be the Anſwer.

Application.

Let this Queſtion be propoſed, *viz.*

If the Carriage of 25 Stone-weight for 16 Miles coſt 15*l.* 10*s.* what will 40 Stone coſt for 9 Miles?

Here of the five given Numbers 25 Stone, 16 Miles, and 15*l.* 10*s.* are conjoined in Form of a Suppoſition, and thereupon a Queſtion is raiſed concerning 40 Stone for 9 Miles; wherefore let either of the two Numbers 40 Stone or 9 Miles be put for the third Number of the firſt Stating and its correſponding Term, 25 Stone or 16 Miles.

	Sto.	*l.*	*s.*	*Sto.*		*l.*	*s.*	
1	25—	15	10—	40	*Anſw.*	24	16	
	Miles	*l.*	*s.*	*Miles*		*l.*	*s.*	
2	16—	24	16—	9	*Anſw.*	13	19	

Or thus:

	Miles	*l.*	*s.*		*Miles*		*l.*	*s.*	*d.*
1 ..	16—	15	10—		9	*Anſw.*	8	14	4½
	Sto.	*l.*	*s.*	*d.*	*Sto.*		*l.*	*s.*	
2 ...	25—	8	14	10½—	40	*Anſ.*	13	9	

Such Queſtions as (being ſtated) are found to have both the Statings in direct Proportion, may be ſolved more readily by one compound Stating and Operation, thus: Place the two Terms of which the Queſtion is raiſed under one another in the third Place; their correſpondent Terms under each other in the firſt; and the remaining Term in the Middle: Then multiply both theſe firſt Terms and third Terms into each

each other and so the double Stating is reduced to a simple Stating of the *Rule of Three Direct*, *viz.* the Product of the two first Terms is the first of a simple Stating; the second Term is the second; and the Product of the third Terms is the third Number to find a fourth Proportional.

So the first Example will stand thus:

```
                l.  s.
Sto.  25———————15   10———————40 Sto.
Mi.   16       20             9 Mi.
      ——       ——            ——
      150      310           360
      25       360
      ——       ——
      400      186
               93
              ————           2|0) 27|9
      4|00) 1116|00          ————————
              ————     Answ. l.13  19
               279           ————————
```

Contraction.

Questions in this Rule may be contracted as in the *Rule of Three*, particularly if any of the first and last Terms have a common Measure we may divide them, and use the Quotients instead of the Numbers themselves, by which Means the last Question will stand thus, *viz.*

```
5  25———————15  10———————40  8
2  16            9        9
—           —————         —
10     1|0) 13|9  10
            —————
    Answer, l.13  19
            —————
```

Questions *belonging to this Rule are such as follow:*

1. If 4 Students spend 19*l.* in 3 Months; how much will serve 8 Students 9 Months? *Answer*, 114*l.*

2. If

2. If the Carriage of 8 Cwt. 128 Miles cost 48 Shillings, for how much may I have 4 Cwt. carried 32 Miles after the same Rate? *Answer*, 6*s*.

3. If 240*l*. in 16 Months gain 64*l*. how much will 60*l*. gain in 6 Months? *Answer*, 6*l*.

4. A Merchant agrees with a Carrier to carry 15 Cwt. of Goods 40 Miles for 10 Crowns, each Crown 65 Pence; how much must one pay in Proportion to have 6 Cwt. carried 32 Miles? *Answer*, 17*s*. 4*d*.

5. If 20 Cwt. is to be carried 50 Miles for 5*l*. how much will 40 C. cost if it was to be carried 100 Miles?
Answer, 20*l*.

6. With how many Pounds *Sterling* could I gain 5*l*. *per Annum*, if with 450*l*. I gain in 16 Months 30*l*.
Answer, 100*l*.

7. If 8*l* is gained in 12 Months with 100*l*. with how much Money can I gain 8*l* 12*s*. in 5 Months?
Answer, with 258*l*.

8. If 60*l*. in 6 Months gain 6*l*. what will 240*l*. gain in 16 Months? *Answer*, 64*l*.

9. If 1 Pound of Thread makes 3 Yards of Linen 5 Quarters broad; how many Pound of Thread would be wanted to make a Piece of Linen 45 Yards long, and 1 Yard broad?
Answer, 12 Pound.

10. If 200lb of Merchandize is carried 40 Miles for 3 Shillings; how many Pounds may be carried 60 Miles for 22*l*. 14*s*. 6*d*.? *Answer*, 20200lb.

11. If for 3 Shillings 200lb of Goods are carried 40 Miles; how many Miles might 20200lb be carried for 22*l*. 14*s*. 6*d*.? *Answer*, 60 Miles.

12. If 200lb are carried 40 Miles for 3 Shillings; how much must be paid for carrying 20200lb 60 Miles?
Answer, *l*. 22 14 6.

13. If

13. If 3lb of Worsted make 10 Yards of Stuff of 1 *Yd.* 2*qrs.* broad; how many Pounds will be wanted to make a piece 100 *Yds.* long and 3*qrs.* broad? *Answer*, 15lb.

14. If a Footman travel 240 Miles in 12 Days when the Day is 12 Hours long; in how many Days may he travel 720 Miles when the Day is 16 Hours long?
Answ. 27 Days.

15. If 12 Men in 8 Days gain 8*l.* 8*s.* what will 21 Men gain in 15 Days? *Answer*, 27*l.* 11*s.* 3*d.*

16. What is the Interest of 200*l.* for three Years and 9 Months, at 5 *per Cent. per Annum?* *Answer*, 37*l.* 10*s.*

17. If 80,000 C. wt. of Ammunition was to be removed from a Place in 9 Days, and that in 6 Days Time I find 4500 C.wt. is carried away by 18 Horses, how many Horses would be wanted to carry away the remainder in 3 Days?
Answer, 604 Horses.

---

† 18. A and B are on opposite Sides of a Wood, 134 Fathoms about, They begin to go round it both the same Way at the same Instant of Time; A goes 11 Fathoms in two Minutes, and B 17 in 3: the Question is, how many Times will they surround this Wood, before the nimbler overtakes the slower?

Answer, $\begin{cases} \text{17 Times by A.} \\ 16\frac{1}{2}\text{——by B.} \end{cases}$

19. A Weight of $1\frac{1}{2}$lb. laid on the shoulder of a Man is no greater Burthen to him than its absolute Weight; what Difference will he feel between the said Wt. applied near his Elbow, at 12 Inches from the shoulder, and in the Palm of his Hand 28 Inches therefrom; and how much more must his Muscles then draw to support it at Right Angles; that is, have his Arm extended right out? *Answer*, 24lb.

BOOK II.

CHAP. I.

OF FRACTIONS.

DEFINITIONS.

1. A FRACTION is a Part or Parts of Unity [repreſenting any whole which may be divided.]

2. A Fraction is expreſſed by two Numbers placed one above the other with a Line drawn between them, as $\frac{1}{2}$, $\frac{2}{3}$; the Number above the Line is called the Numerator, and the Number below the Line the Denominator,

$$e.g.\ \frac{1}{2}\ \frac{3}{5}\ \frac{11}{12}\ \begin{matrix}\text{Numerator,}\\ \text{Denominator,}\end{matrix}\quad \text{which are}$$

read thus, one Half, three Fifths, eleven Twelfths.

3. The Numerator denotes how many Parts of the Whole the Fraction conſiſts of.

4. The Denominator denotes how many Parts the Whole is divided into.

5. A proper Fraction is that whoſe Numerator is leſs than its Denominator, as $\frac{1}{2}$, $\frac{3}{4}$.

6. An improper Fraction is that whoſe Numerator is equal to, or greater than its Denominator, as $\frac{2}{1}$, $\frac{4}{3}$, $\frac{4}{4}$.

7. A compound Fraction is a Fraction of a Fraction, as $\frac{1}{2}$ of $\frac{3}{14}$ or $\frac{1}{3}$ of $\frac{1}{12}$ of $\frac{1}{26}$.

8. A whole Number with a Fraction annexed, is called a mixed Number, as $2\frac{2}{5}$, $1\frac{1}{2}$.

9. A Fraction is ſaid to be in its leaſt Terms, when it is expreſſed by the leaſt Numbers poſſible.

Queſt. What is a Fraction?

A. A Part or Parts of one whole Thing.

Q. How is a Fraction expreſſed?

A. By

A. By two Numbers placed one above the other, with a Line drawn between them.

Q. What are these Numbers called?

A. That above the Line is called the Numerator; and that below the Denominator.

Q. What is a proper Fraction?

A. That whose Numerator is less than the Denominator,

Q. What is an improper Fraction?

A. That whose Numerator is equal to, or greater than the Denominator.

Q. What is a compound Fraction?

A. A Fraction of a Fraction, as $\frac{1}{2}$, of $\frac{3}{4}$.

Q. What is a mixt Number?

A. A whole Number with a Fraction annexed, as $2\frac{2}{3}$.

CHAP. II.

REDUCTION OF FRACTIONS.

1st Preparatory Problem.

TO find the greatest common Measure of two given Numbers,

Rule.

The greater by the less divide;
The less by what remains beside;
The last Divisor, still again,
By what remains, till Nought remain:
And what divides and leaveth Nought,
Will be the common Measure sought.

Examples.

1. What is the greatest common Measure of 112 and 120? *Answer*, 8.
2. What is the greatest common Measure of 26 and 62? *Answer*, 2.
3. What is the greatest common Measure of 279 and 403? *Answ.* 31.

2d Preparatory Problem.

To find the least common Multiple of any given Numbers.

Their Product, if each prime to th' rest,
Of all that they'll divide's the least.
If all not prime to all beside,
See what will two or more divide:
Divide the two or more thereby,
The like upon the Quotients try;
And if thou canst divide 'em, do;
Till Nought will measure any two;
Then the last Quotients multiply'd,
And all the Numbers which divide
Continually; the Product got
Will be the Multiple that's sought.

Examples.

What is the least common Multiple of 3, 5, 8 and 10?

5) 3, 5, 8, 10
2) 3, 1, 8, 2
3, 1, 4, 1

$$\begin{array}{r} 3 \\ \hline 12 \\ 2 \\ \hline 24 \\ 5 \\ \hline 120 \end{array}$$

Answ. 120

I survey my given Numbers and discover 5 will divide two of them, *viz.* 5 and 10 which I divide by 5, bringing into a Line with the Quotients the Numbers, which 5 will not measure: Again, I view the Numbers in the second Line, and find 2 will measure 8 and 2, and these I divide by 2, and in the third Line get 3, 1, 4, 1, all prime, I multiply the Numbers in the said Line together with the Divisors continually into each other for the Number sought, and find it 120.

4. What is the least Number which 3, 4, 8, and 12 will measure? *Answ.* 24.

5. What Number is the least that 7, 8, 16 and 28 will measure? *Answ.* 112.

6. What is the least Number which 5, 6, 12 and 16 will measure? *Answ.* 240.

Problem I.

To reduce a Fraction to its least Terms.

Rule.

Find the greatest common Measure of the Numerator and Denominator of the given Fraction, and divide them thereby,

by, the Quotients will be the leaſt Term required, *viz.* the Quotient found by dividing the Numerator will be the Numerator, and the Quotient of the Denominator, the Denominator of the Fraction required.

Ex mples.

Bring the following Fractions to their leaſt Terms:

7. $\frac{144}{256}$	*Anſwer,*	$\frac{9}{16}$	10. $\frac{48}{56}$	*Anſwer,*	$\frac{6}{7}$
8. $\frac{91}{117}$	———	$\frac{7}{9}$	11. $\frac{182}{196}$	———	$\frac{13}{14}$
9. $\frac{744}{899}$	———	$\frac{24}{29}$	12. $\frac{216}{240}$	———	$\frac{9}{10}$

Rule. II.

Take any common Meaſure of the Numerator and Denominator of the given Fraction, and divide them thereby making the Quotients reſpectively the Numerator and Denominator of a new Fraction, which divide in like Manner, and ſo proceed till the Terms be prime to each other, and the Thing propoſed is manifeſtly effected.

Examples.

Bring $\frac{56}{84}$ to its loweſt Terms.

$$2.\ \left\{\frac{56}{84}\right.\ \Bigg|\ \overset{2)}{\frac{28}{42}}\ \Bigg|\ \overset{7)}{\frac{14}{21}}\ \Bigg|\ \frac{2}{3}\qquad \textit{Anſwer, } \tfrac{2}{3}.$$

Note, If the Numerator and Denominator be both even, 2 is a common Meaſure to them. If one be odd (if they have any) their common Meaſure is ſome odd Number, as 3, 7, 11, &c. If both have for their loweſt Figure 5, or one 5, and the other a Cypher, 5 is a common Meaſure; and if both have Cyphers in Units Place, &c. cut off the Cyphers, 10, or 100, &c. being a common Meaſure.

Bring the following Fractions to their loweſt Terms, *viz.*

13. $\frac{24}{28}$	*Anſwer,*	$\frac{6}{7}$	17. $\frac{120}{160}$	*Anſwer,*	$\frac{3}{4}$
14. $\frac{21}{36}$	———	$\frac{7}{12}$	18. $\frac{4800}{7650}$	———	$\frac{32}{51}$
15. $\frac{21}{35}$	———	$\frac{3}{5}$	19. $\frac{150}{300}$	———	$\frac{1}{2}$
16. $\frac{8}{16}$	———	$\frac{1}{2}$	20. $\frac{350}{400}$	———	$\frac{7}{8}$

Problem II.

To change or reduce a given Fraction to another which shall be equal thereto, and have a given Denominator.

Rule.

Multiply the given Denominator by the Numerator of the given Fraction, and divide the Product by the Denominator thereof, and the Quotient will be the Numerator of the Fraction sought.

Otherwise thus:

Divide the given Denominator by the Denominator of the given Fraction, and multiply the Quotient by the Numerator.

Examples.

21. Reduce $\frac{2}{3}$ to a Fraction whose Denominator shall be 15. *Answ.* $\frac{10}{15}$.

22. Bring $\frac{4}{5}$ to a Fraction whose Denominator shall be 15. *Answ.* $\frac{12}{15}$.

23. Reduce both $\frac{7}{8}$ and $\frac{13}{28}$ to Fractions whose Denominators shall be 112. *Answer,* $\frac{98}{112}$ and $\frac{52}{112}$.

24. Reduce $\frac{3}{4}$ to a Fraction whose Denominator shall be 100. *Answer,* $\frac{75}{100}$.

25. Reduce $\frac{5}{8}$ to a Fraction whose Denominator shall be 1000. *Answer,* $\frac{625}{1000}$.

Problem III.

To reduce any given Fractions to others, which shall have one common Denominator.

Rule.

1. Find the least Number which all the Denominators of the given Fractions will measure, for a common Denominator.

2 Reduce each Fraction to another whose Denominator, shall be the said common Denominator.

Examples.

Examples.

Reduce the following Fractions to others equal thereto, which shall have a common Denominator.

26.	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{5}{6}$	*Answer,*	$\frac{6}{12}$	$\frac{8}{12}$	$\frac{9}{12}$	$\frac{10}{12}$
27.	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{5}$	———	$\frac{60}{120}$	$\frac{40}{120}$	$\frac{30}{120}$	$\frac{24}{120}$
28.	$\frac{3}{8}$	$\frac{4}{9}$	$\frac{6}{13}$		———	$\frac{351}{936}$	$\frac{416}{936}$	$\frac{432}{936}$	
29	-	-	$\frac{3}{4}$	$\frac{11}{12}$	———	$\frac{9}{12}$	$\frac{11}{12}$		
30.	$\frac{2}{5}$	$\frac{4}{6}$	$\frac{5}{9}$	$\frac{7}{10}$	———	$\frac{36}{90}$	$\frac{60}{90}$	$\frac{50}{90}$	$\frac{63}{90}$
31.	-	$\frac{7}{8}$	$\frac{9}{14}$		———	$\frac{49}{56}$	$\frac{36}{56}$		
32.	$\frac{5}{7}$	$\frac{3}{8}$	$\frac{13}{16}$	$\frac{27}{28}$	———	$\frac{80}{112}$	$\frac{42}{112}$	$\frac{91}{112}$	$\frac{108}{112}$
33.	$\frac{11}{12}$	$\frac{9}{16}$	$\frac{18}{20}$	$\frac{13}{24}$	———	$\frac{220}{240}$	$\frac{135}{240}$	$\frac{216}{240}$	$\frac{130}{240}$

Problem IV.

To Reduce an improper Fraction to a whole or mixed Number.

Rule.

Divide the Numerator by the Denominator, and the Quotient is the whole or mixed Number required.

Examples.

34. Bring $\frac{95}{19}$ to a whole Number. *Answer,* 5.

35.	$\frac{45}{13}$	*Answer,* $3\frac{6}{13}$		39.	$\frac{87}{8}$	*Answer,* $10\frac{7}{8}$
36.	$\frac{25}{7}$	——— $3\frac{4}{7}$		40.	$\frac{96}{16}$	——— 6
37.	$\frac{144}{18}$	——— 8		41.	$\frac{600}{19}$	——— $31\frac{11}{19}$
38.	$\frac{1726}{31}$	——— $55\frac{21}{31}$		42.	$\frac{573}{16}$	——— $35\frac{13}{16}$

Problem V.

To reduce a whole or mixed Number to an improper Fraction.

I. *A Whole Number.*

1. Subscribe 1 under the given whole Number, for a Denominator to express it Fraction-wise, as 8, $\frac{8}{1}$; 17, $\frac{17}{1}$.

2. But if it be required to reduce a whole Number, to a Fraction, whoſe Denominator is given; multiply the ſaid whole Number by the given Denominator for a Numerator to ſaid Denominator.

As ſuppoſe 7 given to be reduced to a Fraction whoſe Denominator ſhall be 4; now 7 multiplied by 4 makes 28 for the Numerator of $\frac{28}{4}$, the Fraction required.

Examples.

43. Bring 5 to a Fraction whoſe Denominator is 19?
Anſwer, $\frac{95}{19}$.

44. Reduce 8 to a Fraction whoſe Denominator is 18?
Anſwer, $\frac{144}{18}$.

45. Reduce 6 to a Fraction whoſe Denominator is 16?
Anſwer, $\frac{96}{16}$.

II. *A mixt Number.*

Multiply the whole Number by the Denominator of the annexed Fraction, and add the Numerator to the Product for the Numerator of the improper Fraction required, and the Denominator of the Fractional part is the Denominator.

Application.

Let $3\frac{2}{4}$ be given to be reduced to an improper Fraction, I multiply 3 by 4 and the Product is 12, to which adding 2 the Numerator of the Fractional Part, the Sum 14 is the Numerator of the Fraction sought, and 4 the Denominator; ſo then $\frac{14}{4}$ is the improper Fraction equal to $3\frac{2}{4}$ *Q. E. I.*

$3\frac{1}{2}$	$3\frac{2}{4}$
2	4
Anſw. $\frac{7}{2}$	*Anſw.* $\frac{14}{4}$

Examples.

Reduce the following mixt Numbers to improper Fractions.

46.	$3\frac{6}{13}$	*Anſwer,*	$\frac{45}{13}$
47.	$3\frac{4}{7}$	———	$\frac{25}{7}$
48.	$55\frac{21}{31}$	———	$\frac{1726}{31}$
49.	$10\frac{7}{8}$	———	$\frac{87}{8}$
50.	$31\frac{11}{19}$	———	$\frac{600}{19}$
51.	$35\frac{13}{16}$	———	$\frac{573}{16}$

Of

Of Compound Fractions:

Problem VI.

To reduce a compound Fraction to a single Fraction.

Rule.

Multiply the Numerators together for a Numerator and, the Denominators for a Denominator.

52.	$\frac{1}{2}$ of $\frac{1}{12}$ of $\frac{1}{10}$	*Answer,*	$\frac{1}{240}$
53.	$\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$	———	$\frac{24}{60}$ or $\frac{2}{5}$
54.	$\frac{3}{4}$ of $\frac{16}{25}$	———	$\frac{48}{100}$
55.	$\frac{1}{2}$ of $\frac{1}{4}$	———	$\frac{1}{8}$

Note, If any Denominator of 1 Member of a compound Fraction be equal to the Numerator of another Member thereof, these equal Numerators and Denominators may be erased, and the other Members continually multiplied, (as *per* Rule) will produce the Fraction required in lower Terms. For instance, if it be required to reduce $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ to a simple Fraction, erasing the equal Numerators they will stand thus, $\frac{2}{\cancel{3}}$ of $\frac{\cancel{3}}{\cancel{4}}$ of $\frac{\cancel{4}}{5}$; then 2 being the only Numerator not erased, and 5 the only Denominator, the Fraction $\frac{2}{5}$ is that required, and equal to the Fraction which would be produced by the continual Multiplication of the Numerators and Denominators; For it it manifest the Numerator 2 of the Fraction $\frac{2}{5}$ is to be multiplied by 3 and 4, and the Denominator 5 by the same, in which case the Fraction produced will be equal to the Fraction multiplied.

Problem VII.

To find what Fraction of a higher or greater Denomination, a lesser or divers lesser Denominations are.

Rule.

Reduce the given Denominators to the lowest mentioned for a Numerator, and Unity, of which they are to be the

Fraction to the ſame, for a Denominator, and bring the Fraction ſo found to its leaſt Terms.

Application.

Suppoſe 17*s*. 6*d* be given to find what Part of a Pound it is, I bring 17*s*. 6*d*. into Pence, the leaſt Denomination mentioned, and find it 210 Pence for a Numerator, and then 1 *l*. brought to the ſame name makes 240 Pence for a Denominator, and $\frac{210}{240}$ reduced to its leaſt Terms is $\frac{7}{8}$ of a Pound equal to 17*s*. 6*d*..

	s.	*d*.	*l*.
	17	6	1
	12		20
	——		——
	21|0 (7		20
3)	——		12
	24|0 (8		——
			240
	Anſwer. $\frac{7}{8}$		

Examples.

56. What Part of a Pound is 13*s*. 4*d*.? *Anſw* $\frac{2}{3}$
57. What Part of a Shilling is 3*d*.? —— $\frac{1}{4}$
58. What Part of a Yard is 3*qrs*. 3*Na*? —— $\frac{15}{16}$
59. What Part of a C.wt. is 3*qrs*. 14 lb.? —— $\frac{7}{8}$
60. What Part of a Pound is 7*oz*. 10*drs*.? —— $\frac{61}{128}$
61. What Part of a *l*. Ster. is 17*s* $9\frac{1}{2}$*d*.? —— $\frac{427}{480}$
62. What Part of a Hogſhead is 9 Gallons? —— $\frac{1}{7}$
63. What Part of a Day is 4*ho*. 20*mi*? —— $\frac{13}{72}$
64. What Part of a lb *Troy* is 10*oz*. 10*dwt*. 10*gr*. —— $\frac{505}{576}$

Problem VIII.

To find the value of a Fraction, *viz*. Having given a Fraction of a greater Denomination, to find how many of the leſſer are equal thereto.

Rule.

Multiply the Numerator of the given Fraction by that Number which one of the greater containeth of the leſſer, and divide the Product by the Denominator, and if any Thing remain, multiply the Remainder by the Number which one of the Denomination laſt found contains of the next leſſer, and ſo proceed till nothing remains, or the

lowest

lowest be come to, and the several Quotients express the Denominations equivalent to the Fraction given.

Application.

```
     7
    20
   ----
8) 140
   ----
   17  4 remains.
      12
     ----
   8) 48
     ----
       6
```

Let $\frac{7}{8}$ of a Pound be given to find its Value; I multiply 7 by 20 the Number of Shillings in 1*l.* and the Product 140 I divide by the Denominator 8, and get the Quotient 17, the Number of twentieth Parts or Shillings; and 4 remaining, I multiply it by 12, and again, divide the Product by 8, find the Quotient 6 for Pence, and Nothing remaining, I bring the Quotients together and thereby find 17*s.* 6*d* the lesser Denominations equal to $\frac{7}{8}$*l.*

Answer, 17*s.* 6*d.*

Examples.

65. Find the Value of $\frac{2}{3}$*l.*? *Answ.* 13*s.* 4*d.*
66. How much is $\frac{1}{4}$ of a Shilling? —— 3*d.*
67. What is the $\frac{15}{16}$ of a Yard? —— 3*qrs.* 3 *Na.*
68. How much is $\frac{7}{8}$ of a C.wt.? —— 3*qrs.* 14 lb.
69. How much is $\frac{61}{128}$ of a lb *Avoirdupois*? — 7*oz.* 10*dr.*
70. How much is $\frac{427}{480}$ of a *l.* Sterling? —— 17*s.* 9$\frac{1}{2}$*d.*
71. How much is $\frac{1}{7}$ of a Hhd. of Wine? — 9 Gallons.
72. How much is $\frac{505}{576}$ of a lb *Troy*?

Answer, 10*oz.* 10*dwt.* 10*grs.*

Problem IX.

To reduce a Fraction of a lower Denomination to a Fraction of a higher.

Rule.

Make it a compound Fraction and reduce it to a simple one.

Application.

Application.

Let it be required to bring $\frac{3}{4}$ of a Shilling to the Fraction of a Pound. From what hath been remarked it will be very easy to conceive that $\frac{3}{4}$ of a Shilling is $\frac{3}{4}$ of $\frac{1}{20}$ of a *l.* which being reduced to a simple Fraction becomes $\frac{3}{80}$ of a *l.* equal $\frac{3}{4}$*s.*

Examples.

73. What Part of a *l.* is $\frac{1}{2}$*d.*? *Answer*, $\frac{1}{480}$.
74. What Part of a lb *Avoirdupois* is $\frac{3}{4}$ of an ounce? *Answer*, $\frac{3}{64}$.
75. What Part of a C.wt. is $\frac{7}{8}$ of 1 lb.? —— $\frac{7}{896}$.
76. What Part of a Yard is $\frac{2}{3}$ of a Nail? —— $\frac{1}{24}$.

Problem X.

To reduce a Fraction of a higher Denomination to the Fraction of a lower.

Rule.

Multiply the Numerator of the given Fraction, by that Number which 1 of the higher contains of the lower, for a new Numerator to the Denominator of the given Fraction.

Application.

Let it be required to bring $\frac{7}{8}$ of a *l.* to the Fraction of a Shilling, multiply 7 by 20, I find the Product 140, *viz.* $\frac{140}{8}$ of a Shilling, (in its least Terms $\frac{35}{2}$*s.*) equal to $\frac{7}{8}$ *l.*

77. What Part of a Shilling is $\frac{2}{3}$*l.*? *Answ.* $\frac{40}{3}$.
78. What Part of a Penny is $\frac{1}{480}$*l.*? —— $\frac{240}{480}$ or $\frac{1}{2}$.

Problem XI.

To find what Part of a greater Number any lesser Number is.

Rule.

Rule.

Make the lesser the Numerator, and the greater the Denominator of a Fraction, and reduce the said Fraction to its lowest Terms.

So if it were required to know what Part 15 is of 20, I say $\frac{15}{20}$, or its lowest Terms $\frac{3}{4}$

QUESTIONS *relating to Reduction.*

Quest. How must I reduce a Fraction to its least Terms?
Answ. By the Measure, the greatest of the Numerator,
Which likewise will measure the Denominator;
Divide both the Terms of the Fraction; 'twill find
The Terms of a Fraction the least in their Kind.
But rather than thus it may probably please
The least Numbers to approximate by Degrees:
If the Numbers be even still 2 will divide,
But an odd Number always in odd must be try'd;
If Cyphers end,—both of like Cyphers deprive;
5, or 5 and a Cypher? —divide them by 5.

Q. How shall I bring a Fraction to another, which shall have a given Denominator?

A. Make the Denominator of the given Fraction the first, the Numerator the second, and the given Denominator the third Number, of a stating in the *Rule of Three*, and find a fourth proportional; which will be the Numerator to the given Denominator.

Q. How must I reduce Fractions of different Denominators to others having one common Denominator?

A. Find the least Number which all the Denominators of the given Numbers will measure, for a common Denominator, and reduce each Fraction to another whose Denominator shall be the said common Denominator.

Q. How must I reduce an improper Fraction to a whole or mixt Number?

A. Divide the Numerator by the Denominator.

Q. How must I make a whole Number an improper Fraction?

A. By

A. By ſubſcribing 1 under it for a Denominator.

Q. But if the Denominator be given?

A. Multiply the whole Number thereby for a Numerator.

Q. How muſt I reduce a mixt Number to an improper Fraction?

A. Multiply the whole Number by the Denominator of the annexed Fraction, and add the Numerator to the Product for the Numerator, and the Denominator of the Fractional Part is the Denominator.

Q. How muſt I bring a compound Fraction to a ſimple one?

A. Multiply all the Numerators together for a Numerator, and the Denominators for a Denominator.

Q. How muſt I bring Numbers of leſſer Denominations to the Fraction of a greater?

A. Reduce the given Denominations to the leaſt mentioned for a Numerator, and one of the greater to the ſame for a Denominator.

Q. How muſt I find the value of a Fraction, which is a Part of a Unit of Coin, Weight and Meaſure. *&c.*

A. If of Coin, Weight or Meaſure the Fraction is aſſign'd
In the Tables the fit Multipliers we find.
So multiply by 20 the given Numerator,
The Product divide by the Denominator,
The Shillings contain'd in the Quotient are found;
If the Fraction propos'd be the Parts of a Pound;
Multiply next by 12 the remainder from thence,
The Product divide as before for the Pence;
Repeat the like Proceſs again and again,
Till the loweſt Name's got, or till Nothing remain.

CHAP. III.

ADDITION OF FRACTIONS.

Rule I.

IF the Fractions have a common Denominator, add the Numerators together, and under their Sum place the common Denominator; if the Sum be an improper Fraction it may be reduced to a mixt Number, if not to the leaſt Terms.

Examples.

Examples.

(1)		(2)	(3)	(4)	(5)	(6)
$\frac{3}{5}$	3	$\frac{5}{12}$	$\frac{7}{24}$	$\frac{11}{20}$	$\frac{16}{24}$	$\frac{7}{16}$
$\frac{1}{5}$	1	$\frac{1}{12}$	$\frac{11}{24}$	$\frac{9}{20}$	$\frac{19}{24}$	$\frac{13}{16}$
			$\frac{13}{24}$	$\frac{17}{20}$	$\frac{17}{24}$	$\frac{15}{16}$
$\frac{4}{5}$	4					

Rule II.

If the fractions have different Denominators reduce them to equivalent Fractions which ſhall have one common Denominator, and add the ſaid equivalent Fractions, (*per* laſt Rule.)

Application.

$\frac{1}{2}$ 6   12 com. Den.
$\frac{2}{3}$ 8
$\frac{3}{4}$ 9

$1\frac{11}{12}$ 23

12(23 (1
12

11

12

If $\frac{1}{2}$, $\frac{2}{3}$ and $\frac{3}{4}$ were given to be added, I find 12 the leaſt common Denominator, and $\frac{6}{12}$, $\frac{8}{12}$ and $\frac{9}{12}$, equal to the given Fractions; which having a common Denominator may be added, and their Sum is $\frac{23}{12}$, which brought to a mixt Number is $1\frac{11}{12}$, the Sum of the given Fractions.

7. Add $\frac{2}{3}$ $\frac{5}{6}$ and $\frac{3}{8}$ together. *Anſwer,* $1\ \frac{7}{8}$
8. —— $\frac{5}{8}$ $\frac{1}{7}$ $\frac{4}{9}$ $\frac{1}{8}$ ———— $1\ \frac{1}{[illegible]}$
9. —— $\frac{3}{4}$ $\frac{11}{12}$ ———— $1\ \frac{2}{3}$
10. —— $\frac{1}{8}$ and $\frac{5}{6}$ ———— $\frac{23}{24}$
11. —— $\frac{1}{2}$ $\frac{3}{4}$ $\frac{5}{8}$ ———— $1\ \frac{7}{8}$
12. —— $\frac{7}{32}$ $\frac{5}{64}$ $\frac{5}{128}$ ———— $\frac{35}{128}$
13. —— $\frac{1}{3}$ $\frac{1}{5}$ $\frac{1}{6}$ $\frac{1}{7}$ $\frac{1}{8}$ ———— $\frac{271}{280}$
14 —— $\frac{4}{5}$ $\frac{1}{6}$ $\frac{6}{7}$ $\frac{3}{8}$ and $\frac{8}{11}$ ———— $3\ \frac{5477}{9240}$
15. —— $\frac{13}{36}$ $\frac{11}{18}$ $\frac{7}{12}$ $\frac{4}{9}$ $\frac{5}{6}$ $\frac{2}{3}$ ———— $3\ \frac{1}{2}$

Rule III.

To add mixt Numbers.

Add the Fractions as before and if the Sum of the Fractions found be an improper Fraction, reduce it to a mixt Number, and add the Integral Part with the whole Numbers of the given mixt Numbers.

Application.

Application.

So $5\frac{1}{2}$, $7\frac{7}{8}$ and 15 being given to be added: I first find the Sum of $\frac{1}{2}$ and $\frac{7}{8}$ to be $\frac{11}{8}$ which is found equal to $1\frac{3}{8}$, I put down $\frac{3}{8}$ for the Fractional Part of the Sum and carry 1, the Integral part of the Units of the given whole Numbers, and adding them the Sum is found $28\frac{3}{8}$

$5\frac{1}{2}$	. . . 4	(8
$7\frac{7}{8}$	. . . 7	
15		
$28\frac{3}{8}$	11	
	8) 11	
	$1\frac{3}{8}$	

Examples.

[16]	[17]	[18]	[19] *l.*	*s.*	*d.*
$327\frac{1}{2}$	$97\frac{1}{8}$	$84\frac{5}{7}$	12	19	$2\frac{1}{8}$
$64\frac{2}{3}$	$36\frac{5}{12}$	$69\frac{3}{4}$	00	18	$6\frac{13}{24}$
$95\frac{1}{4}$	$124\frac{9}{32}$	$17\frac{5}{28}$	00	04	$7\frac{181}{336}$
	$54\frac{18}{112}$	$154\frac{13}{224}$	00	2	$3\frac{117}{672}$

QUESTIONS FOR EXERCISE.

1. A Merchant buys 5 Pieces of Cloth, the first was $40\frac{3}{4}$ Yards; the second $27\frac{1}{2}$ Yards; the third $34\frac{7}{8}$ Yards; the fourth $43\frac{3}{16}$, and the fifth $39\frac{1}{4}$ Yards: I desire to know how many Yards were in the 5 Pieces?

Answ $185\frac{9}{16}$ Yards.

2 Bought 4 Bales of Spice. No. 1. Weight $150\frac{1}{2}$ lb; No. 2 Weight $139\frac{3}{4}$ lb; No. 3. Weight $162\frac{2}{3}$ lb; No. 4. Weight $170\frac{1}{8}$ lb.; How many lb weighed they together?

Answ. $623\frac{1}{24}$ lb.

3. A Grocer sold the following Parcels of Sugar, *viz.* $16\frac{1}{2}$ lb; $19\frac{1}{4}$ lb; $13\frac{3}{4}$ lb; $20\frac{1}{8}$ lb; $25\frac{1}{16}$ lb; $30\frac{5}{8}$ lb; and $11\frac{1}{4}$ lb: I demand how many Pounds he sold in all?

Answer, $136\frac{27}{48}$ lb.

CHAP.

CHAP. IV.

SUBTRACTION OF FRACTIONS.

SUBTRACTION of Fractions is the taking of a lesser Fraction from a greater; likewise, a mixt Number or Fraction from a greater mixt Number or whole Number.

I. *Fractions which have a common Denominator:*

Subtract the Numerator of the less from the Numerator of the greater, and to their Difference subscribe the common Denominator; so is this new Fraction the Difference of the given Fractions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
From	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{36}{39}$	$\frac{28}{40}$	$\frac{9}{11}$	$\frac{11}{21}$
Take	$\frac{1}{3}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{13}{39}$	$\frac{5}{40}$	$\frac{7}{11}$	$\frac{17}{21}$
Rem.	$\frac{1}{3}$						

II. *When they have not a common Denominator.*

Reduce them to a common Denominator, and then work as *per* last.

From $\frac{7}{8}$ take $\frac{2}{3}$.

$\left.\begin{array}{l} \frac{7}{8} \ldots 21 \\ \frac{2}{3} \ldots 16 \end{array}\right\}$ (24 common Denominator; Numerators.

Answ. $\frac{5}{24}$ 5

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
From	$\frac{11}{12}$	$\frac{3}{4}$	$\frac{1}{3}$	$\frac{75}{150}$	$\frac{24}{30}$	$\frac{127}{240}$	$\frac{224}{356}$
Take	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{15}{60}$	$\frac{13}{23}$	$\frac{127}{480}$	$\frac{13}{144}$
Rem.							

III. *A*

III. *A Fraction from a whole Number.*

Subtract the Numerator of the Fraction from its Denominator, and place the remainder over the Denominator, for the Fractional Part of the Difference sought; then subtract 1 from the given whole Number, for the Integral Part of the Remainder; So is a Fraction or mixt Number found which shall be the Remainder or Difference required.

Application and Reason.

Let it be required to take $\frac{1}{4}$ from 2; I take 1 the Numerator of $\frac{1}{4}$ from the Denominator 4, and 3 the Remainder I put for a Numerator over the Denominator, *viz.* $\frac{3}{4}$, the Fraction remaining; then I take 1 from the given whole Number 2 and 1 remains; So is the Remainder found $1\frac{3}{4}$ *Q. E. I.*

From	$2\frac{0}{0}$
Take	$0\frac{1}{4}$
Rem.	$1\frac{3}{4}$

	[15]	[16]	[17]	[18]	[19]	[20]
From	1	3	7	8	9	12
Take	$0\frac{2}{3}$	$0\frac{3}{4}$	$0\frac{1}{10}$	$0\frac{1}{2}$	$0\frac{4}{7}$	$0\frac{5}{8}$

In like Manner to subtract a mixt Number from a whole Number subtract the Fractional Part as above, and to the lesser whole Number add 1; the Sum take from the greater whole Number.

	[21]	[22]	[23]	[24]	[25]
From	2	3	7	11	135
Take	$1\frac{2}{3}$	$1\frac{3}{4}$	$6\frac{9}{10}$	$6\frac{17}{20}$	$87\frac{3}{11}$

IV. *A Fraction or a mixt Number from a mixt Number when the Fraction to be subtracted is the less.*

Subtract the less Fraction from the greater Fraction, and the less whole Number from the greater.

From

	[26]	[27]	[28]	[29]	[30]
From	$2\frac{2}{3}$	$4\frac{3}{4}$	$9\frac{7}{8}$	$22\frac{35}{39}$	$127\frac{63}{113}$
Take	$0\frac{1}{3}$	$1\frac{1}{4}$	$9\frac{3}{8}$	$0\frac{23}{39}$	$60\frac{17}{113}$
Rem.	$2\frac{1}{3}$				

	[31]			[32]	[33]	[34]	[35]
From	$7\frac{7}{8}$ . .	21	[24	$27\frac{11}{12}$	$19\frac{3}{4}$	$120\frac{75}{100}$	$185\frac{19}{185}$
Take	$3\frac{2}{3}$ . .	16		$0\frac{2}{3}$	$15\frac{1}{2}$	$23\frac{15}{60}$	$0\frac{17}{120}$
Rem.	$4\frac{5}{24}$	5					

V. *A Fraction or a mixt Number from a mixt Number when the Fraction to be ſubtracted is the greater.*

Rule.

1. Reduce the given Fractions to one common Denominator.
2. Then ſubtract the Numerator of the greater Fraction from the common Denominator, and to the Remainder add the Numerator of the leſſer, the Sum is the Numerator to the common Denominator, for the Fractional Part of the Remainder.
3. Carry 1 to the leſſer whole Number, and ſubtract the Sum from the greater.

Application.

Let it be required to take $2\frac{3}{4}$ from $5\frac{1}{2}$.

	$5\frac{1}{2}$ . . .	2
	$2\frac{3}{4}$ . . .	3
Rem.	$2\frac{3}{4}$	3

The given Fractions being brought to one common Denominator will be $\frac{2}{4}$ and $\frac{3}{4}$; I take the greater Numerator 3 from the common Denominator 4, and 1 remains, which added to 2 the leſſer Numerator, makes 3 for the Numerator of the Remaining Fraction $\frac{3}{4}$; then I carry 1 to 2 the leſſer whole Number, makes 3 from 5 and 2 remains; whence the remainder ſought is found $2\frac{3}{4}$.

Examples.

Examples.

	[36]	[37]	[38]	[39]	[40]
From	$2\frac{1}{2}$	$9\frac{4}{7}$	$19\frac{5}{11}$	$13\frac{1}{9}$	$12\frac{3}{8}$
Take	$0\frac{3}{4}$	$6\frac{6}{7}$	$0\frac{7}{15}$	$9\frac{15}{27}$	$9\frac{5}{6}$

QUESTIONS.

Quest 1. What is the Difference of $\frac{9}{14}$ and $\frac{12}{21}$? *Answer*, $\frac{1}{6}$.

2. What differs $\frac{1}{19}$ from $\frac{1}{9}$? *Answer*, $\frac{10}{171}$.

3. What is the Difference between $10\frac{7}{8}$ and $12\frac{1}{2}$? *Answer*, $1\frac{5}{8}$.

4. What differs $\frac{33}{48}$ from 48? *Answer*, $47\frac{5}{16}$

5. Bought a Piece of Cloth containing $47\frac{3}{4}$ Yards, of which I cut $24\frac{15}{16}$ Yards; I demand how much I have by me? *Answer*, $22\frac{13}{16}$ Yards.

6. A Man had 4 Bags of Money containing in all 500*l.* In the first was $130\frac{2}{3}$; in the second $97\frac{11}{20}$; in the third $110\frac{7}{11}$: I want to know what was in the fourth? *Answer*, $161\frac{1}{5}$*l.*

CHAP. V.

MULTIPLICATION OF FRACTIONS.

Rule.

Multiply the Numerators into each other for the Numerator; and the given Denominators for the Denominator of the Product.

Application.

Application.

$$\begin{array}{cccc} & M & N & \\ a & 2 & 3 & c \\ b & 3 & 4 & d \\ & 6 & e & \\ & 12 & f & \\ & & O & \\ g\ 24 & & h\ 36 & \end{array}$$

Let the Fractions M N be given to be multiplied, the Numerators 2 and 3 being multiplied into each other make 6 for the Numerator of the Product O, and 3 multiplied into 4 makes 12 for the Denominator; so $\frac{6}{12}$ or $\frac{1}{2}$ is the Product found by the Rule.

If whole Numbers or mixt Numbers be given to be multiplied, reduce them to improper Fractions, and multiply them by the Rule, and if the Product be an improper Fraction, it may be brought back to a mixt or whole Number.

Examples.

$\frac{3}{5}$ multiply by $\frac{7}{8}$ produces $\frac{21}{40}$,

$$\begin{array}{ccc} 3 & — & 7 \\ — & & — \\ 5 & — & 8 \end{array} \qquad \frac{21}{40}$$

Multiply the following Fractions:

1.	$\frac{3}{4}$ by $\frac{1}{2}$ makes $\frac{3}{8}$	5.	$\frac{10}{17}$ by $\frac{17}{10}$ *Answ.* 1
2.	$\frac{1}{4}$ by $\frac{2}{3}$ — $\frac{1}{6}$	6.	$\frac{128}{135}$ by $\frac{5}{12}$ — $\frac{32}{81}$
3.	$\frac{6}{7}$ by $\frac{1}{3}$ — $\frac{2}{7}$	7.	$\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{4}$ — $\frac{1}{4}$
4.	$\frac{9}{15}$ by $\frac{4}{9}$ — $\frac{4}{15}$	8.	$\frac{2}{3}$ $\frac{3}{4}$ $\frac{4}{7}$ $\frac{7}{21}$ — $\frac{2}{21}$

Note, Where ſeveral Fractions are to be multiplied, if the Numerator of one Fraction be equal to the Denominator of another, theſe equal Numerators and Denominators may be omitted.

II.

Multiply 2 by $\frac{1}{2}$? *Anſwer*, 1

2 expreſſed Fractionally (*per*) $\frac{2}{1}$, *i. e.* 1. } is $\begin{array}{ccc} 2 & — & 1 \\ — & & — \\ 1 & & 2 \end{array}$

Multiply

Multiply the following:

9. 3 by $\frac{3}{4}$	*Answ* $2\frac{1}{4}$	12. 9 by $\frac{1}{5}$	*Answ.* $1\frac{4}{5}$
10. 5 by $\frac{1}{8}$	—— $\frac{5}{8}$	13. 24 by $\frac{5}{6}$	—— 20
11. 12 by $\frac{1}{3}$	—— 4	14. 60 by $\frac{2}{15}$	—— 8

III.

Multiply $4\frac{3}{7}$ by 4 *Answer*, $17\frac{5}{7}$

7

31——4

7——1

124

7) 124

$17\frac{5}{7}$

15. 8 by $5\frac{2}{3}$	*Answ.* $45\frac{1}{3}$	17. 24 by $6\frac{5}{6}$	*Answ.* 164
16. $3\frac{3}{4}$ by 5	—— $18\frac{3}{4}$	18. 112 by $5\frac{1}{2}$	—— 616

Multiply $8\frac{5}{12}$ by $3\frac{3}{8}$

12   8

101——27

12——8

2727

96) 2727 ($28\frac{39}{96}$

192

807

768

39

19. Multiply	$19\frac{4}{7}$ by $23\frac{9}{17}$	*Answer*,	$466\frac{12}{17}$
20. ——	$8\frac{2}{3}$ by $10\frac{4}{5}$	——	$93\frac{3}{5}$
21. ——	$75\frac{3}{4}$ by $100\frac{2}{3}$	——	$7625\frac{1}{2}$
22. ——	$35\frac{13}{16}$ by $11\frac{17}{25}$	——	$418\frac{29}{100}$

Remark.

Remark.

Although the Rule before delivered be universal, as appears by the foregoing Examples, yet the following Method will be generally more convenient in Practice.

I. *To multiply a whole Number by a Fraction.*

Rule.

Multiply the whole Number by the Numerator of the Fraction, and divide that product by the Denominator.

Application.

A	B	E
4		$\frac{3}{4}$ *c* / *d* 3

Let 4 be multiplied by $\frac{3}{4}$; 4 multiplied by the Numerator 3 makes 12, which Product divided by the Denominator 4, the Quotient is 3, which is the Product of 4 multiplied by $\frac{3}{4}$.

Cor. Since 1 doth not multiply a Number, it follows, that when the Numerator of a Fraction is 1, the Product is found by dividing by the Denominator.

Let the Examples of II. be done *per* this.

Again,

To Multiply a whole Number by a mixt Number.

Multiply the whole Number by the integral Part of the mixt Number, and then by the fractional Part, and add the Products together.

Application.

8	8
$5\frac{2}{3}$	$5\frac{2}{3}$
40	40
$5\frac{1}{3}$	$\frac{1}{3}$ $2\frac{2}{3}$
	$\frac{1}{3}$ $2\frac{2}{3}$
$45\frac{1}{3}$	$45\frac{1}{3}$

As suppose it were required to multiply 8 by 5 and $\frac{2}{3}$; first, 8 multiplied by 5 is 40, and 8 into $\frac{2}{3}$ makes $5\frac{1}{3}$, or else by $\frac{1}{3}$, $2\frac{2}{3}$; and again, by $\frac{1}{3}$, and lastly the Sum of 40 and $5\frac{1}{3}$, is $45\frac{1}{3}$, the Product required.

CHAP. VI.

DIVISION of FRACTIONS.

Rule.

Multiply the Numerator of the Dividend by the Denominator of the Divisor for a Numerator, and the Denominator of the Dividend by the Numerator of the Divisor for the Denominator of the Quotient.

Application.

Application.

Let $\frac{3}{4}$ be to be divided by $\frac{1}{2}$, 3 (the Numerator of the Dividend) multiplying 2 (the Denominator of the Divisor) produces 6 for the Numerator of the Quotient, in like Manner 4 multiplying 1 produces 4 for the Denominator of the Quotient, which is $\frac{6}{4}$ or $1\frac{1}{2}$

A B

a 1 3 c

b 2 4 d

e 6 *i. e.* $1\frac{1}{2}$

f 4

C

Note. Whole Numbers or mixt Numbers must be reduced to improper Fractions.

I.

1. $\frac{2}{3}$ by $\frac{1}{6}$	*Answ.*	4		5. $\frac{6}{9}$ by $\frac{3}{9}$	*Answ.*	2
2. $\frac{1}{6}$ by $\frac{2}{3}$	——	$\frac{1}{4}$		6. $\frac{15}{16}$ by $\frac{5}{8}$	——	$1\frac{1}{2}$
3. $\frac{21}{45}$ by $\frac{3}{5}$	——	$\frac{7}{8}$		7. $\frac{107}{120}$ by $\frac{7}{11}$	——	$1\frac{51}{56}$
4. $\frac{5}{8}$ by $\frac{2}{7}$	——	$2\frac{3}{16}$		8. 1 by $\frac{17}{18}$	——	$\frac{10}{17}$

II.

Divide $\frac{2}{3}$ by 3.

$\frac{3}{1}$ $\frac{2}{3}$

2 9

Answer, $\frac{2}{9}$.

9. $\frac{1}{2}$ by 4	*Answ.*	$\frac{1}{8}$		13. 4 by $\frac{1}{2}$	*Ans.*	8
10. $\frac{2}{5}$ by 10	——	$\frac{1}{25}$		14. 10 by $\frac{2}{5}$	—	25
11. $\frac{5}{8}$ by 24	——	$\frac{5}{192}$		15. 24 by $\frac{5}{8}$	—	$38\frac{2}{5}$
12. $\frac{11}{12}$ by 60	——	$\frac{11}{720}$		16. 60 by $\frac{11}{12}$	—	$65\frac{5}{11}$

III.

Divide $\frac{1}{2}$ by $2\frac{1}{2}$

2

$\frac{5}{2}$ $\frac{1}{2}$

2 2

2 10

$\frac{2}{10}$ $\frac{1}{5}$ *Answ.*

Divide $2\frac{1}{2}$ by $\frac{1}{2}$

$2\frac{1}{2}$

2

$\frac{1}{2}$ $\frac{5}{2}$

10 2

10

2) 10 (5 *Answer.*

$\frac{3}{4}$ by

17.	$\frac{3}{4}$ by $4\frac{1}{2}$	*Answ.*	$\frac{1}{6}$	21.	$4\frac{1}{2}$ by $\frac{3}{4}$	*Answ.*	6
18.	$\frac{1}{5}$ by $1\frac{4}{5}$	——	$\frac{1}{9}$	22.	$1\frac{4}{5}$ by $\frac{1}{5}$	——	9
19.	$\frac{1}{4}$ by $1\frac{5}{8}$	——	$\frac{2}{13}$	23.	$1\frac{5}{8}$ by $\frac{1}{4}$	——	$6\frac{1}{2}$
20.	$\frac{7}{8}$ by $2\frac{1}{2}$	——	$\frac{3}{8}$	24.	$2\frac{1}{3}$ by $\frac{7}{8}$	——	$2\frac{2}{3}$

Divide 3 by $4\frac{4}{5}$

$$\frac{3}{1} \times \frac{24}{5}$$

$$3\left\{\frac{15}{24}\right\}\frac{5}{8}$$

25.	7 by $8\frac{5}{8}$	*Answ.*	$\frac{56}{69}$	29	108 by $6\frac{3}{7}$	*Answ.*	$16\frac{4}{5}$
26.	$25\frac{1}{2}$ by 5	——	$5\frac{1}{10}$	30.	$119\frac{1}{4}$ by 8	——	$14\frac{29}{32}$
27.	34 by $3\frac{7}{9}$	——	9	31.	25 by $3\frac{1}{5}$	——	$7\frac{13}{16}$
28.	$1\frac{1}{9}$ by 15	——	$0\frac{2}{27}$	32.	$9\frac{3}{7}$ by 11	——	$0\frac{6}{7}$

V.

Divide $5\frac{1}{3}$ by $6\frac{1}{2}$

$$\frac{16}{3} \times \frac{13}{2}$$

Answer, $\frac{32}{39}$

33.	$9\frac{3}{4}$ by $13\frac{1}{2}$	*Answ.*	$\frac{13}{18}$	36.	$10\frac{5}{6}$ by $4\frac{2}{3}$	*Answ.*	$2\frac{9}{28}$
34.	$1\frac{1}{13}$ by $5\frac{5}{36}$	——	$\frac{21}{160}$	37.	$60\frac{9}{16}$ by $26\frac{11}{12}$	——	$2\frac{1}{4}$
35.	$6\frac{1}{2}$ by $5\frac{1}{3}$	——	$1\frac{7}{32}$	38.	$1\frac{1}{2}$ by $2\frac{1}{2}$	——	$0\frac{3}{5}$

Note, When the Denominator of the Divisor and of the Dividend are equal, the Quotient may be found by common *Division*, *viz.* by dividing the Numerator of the Dividend by the Numerator of the Divisor, rejecting the common Denominator entirely.

As suppose $\frac{6}{9}$ to be divided by $\frac{3}{9}$, 3 dividing 6 the Quotient is 2, which is likewise the Quotient of $\frac{3}{9}$, 3 dividing $\frac{6}{9}$. See the *Example*, Case I.

G Now

Now this Rule may be made very extensive or universal, thus: Reduce the Divisor and dividend to one common Denominator, and divide the Numerator of the Dividend by the Numerator of the Divisor.

As if $\frac{2}{3}$ were to be divided by $\frac{1}{6}$; $\frac{2}{3}$ is equal to $\frac{4}{6}$, and 1 dividing 4, the Quotient is 4, the true Quotient of $\frac{2}{3}$ divided by $\frac{1}{6}$; or if $\frac{1}{6}$ be divided by $\frac{2}{3}$, *i. e.* $\frac{4}{6}$, 4 dividing 1 the Quotient is $\frac{1}{4}$.

Note, 2. If a whole Number be to be divided by a Fraction, multiply the whole Number by the Denominator of the Fraction, and divide the Product by the Numerator thereof, thus 48 being to be divided by $\frac{4}{7}$, the Quotient is

$$\frac{48 \times 7}{4} = 84.$$

To divide a Fraction by a whole Number, Multiply the Denominator of the given Fraction by the given whole Number for the Denominator of the Quotient, and make the Numerator of the given Fraction the Numerator.

Thus let the Examples of the second Class be resolved.

To divide a mixed Number by a whole Number.

1. If the integral Part of the mixt Number be less than the Divisor, change the mixed Number into an improper Fraction, and divide the said Fraction according to last.

So 1 $\frac{4}{7}$ being to be divided by 4; the mixed Number reduced to an improper Fraction makes $\frac{11}{7}$, which being divided by 4, makes the Quotient $\frac{11}{28}$.

2. But if the integral Part of the mixt Number be greater than the Divisor, Divide the said integral Part by the said Divisor, and if any Thing remain, reckon it together with the Fractional Part, a mixed Number to be divided.

So 13 $\frac{4}{7}$, divided by 4 quotes 3 $\frac{11}{28}$: For 4 in 13 is 3 times and 1 remains, *viz.* 1 $\frac{4}{7}$, which divided by 4, as above, makes $\frac{11}{28}$.

If nothing remains after the Divisor divides the integral Part, then divide the fractional Part as before.

Examples.

39.	Divide	25 $\frac{1}{2}$	by	5	*Ansuer,*	5 $\frac{1}{10}$.
40.	———	1 $\frac{1}{9}$	by	15	———	$\frac{2}{27}$.
41.	———	119 $\frac{1}{4}$	by	8	———	14 $\frac{29}{32}$.

Here

Here I have a mind to ſhew how ſeveral Queſtions, uſually ſolved by the Rule called *Poſition*, may more eaſily and intelligibly be ſolved. In order thereto it is only neceſſary to conſider the Contraſt, already taken notice of between *Addition* and *Subtraction*; between *Multiplication* and *Diviſion*, *viz.* that whatever it effected by the one is unravalled by the other.

One being aſked how old he was anſwered, if my Age be doubled, the $\frac{1}{2}$ and $\frac{1}{4}$ of my Age added to it, more 1 Year, I ſhould be 100 Years old. What is his Age?

Anſwer, 36 Years.

Here from the laſt Number 100 given I eaſily diſcover the Number ſought: for being doubled, *i. e.* multiplied by 2; the $\frac{1}{2}$ and $\frac{1}{4}$ added, that is multiplied likewiſe by $\frac{1}{2}$ and $\frac{1}{4}$, the Sum of the Products more 1, makes 100; Conſequently the Sum of the Products, is 100 leſs 1, *viz.* 99. Then ſince the Number ſought multiplied by 2, by $\frac{1}{2}$, by $\frac{1}{4}$, reſpectively, the Sum of the Products is 99; if it be multiplied by $2\frac{3}{4}$, the Sum of theſe multipliers, the Product will be likewiſe 99. Therefore we have given the Product 99 and the Multiplier $2\frac{3}{4}$ to find the Multiplicand.

From 100
Take 1

$$2\frac{3}{4} = \frac{11}{4} \times \frac{99}{1}$$

$$\begin{array}{r} 4 \\ \hline 11 \\ \hline 4 \end{array} \qquad 396 \qquad 11)\ 396 \ (36$$

$$\begin{array}{r} 2\frac{3}{4} \\ 4 \\ \hline 11 \end{array} \qquad \begin{array}{r} 99 \\ 4 \\ \hline 11)\ 396 \\ \hline 36 \end{array}$$

CHAP. VII.

THE RULE OF THREE IN FRACTIONS.

THE *Rule of Three*, in Fractions is analogous to the *Rule of Three* in whole Numbers, both in the Stating and Operation, For

The first and third Number or Fraction must be of the same Name or Kind, and reduced to Fractions of the same Name or Denominator.

Multiply the second and third Terms together and divide the Product by the first; the Quotient is the fourth Term required; due regard being had to the Rules laid down for multiplying, dividing and reducing Fractions.

Note, When the first Term is 1, the fourth is found by multiplying the second and third; and when the second or third is 1, the fourth is found by dividing the other by the first.

Examples.

1. If $\frac{3}{4}$lb of Sugar cost $\frac{2}{3}s.$ what cost $\frac{7}{8}$lb?

$$\begin{array}{ccccc} \text{lb} & & s. & & \text{lb} \\ \frac{3}{4} & \text{———} & \frac{2}{3} & \text{———} & \frac{7}{8} \end{array}$$

$$\text{Divide by}\text{—}\frac{3}{4} \times \frac{14}{24}\text{—the Product of } \frac{2}{3} \text{ into } \frac{7}{8}.$$

2. If $\frac{3}{8}$ of a Yard cost $\frac{1}{3}\frac{5}{2}l.$ what will $\frac{2}{5}$ Yard cost?
Answer, 10$s.$

3. What will $\frac{8}{9}$lb cost, if $\frac{2}{5}s.$ buy $\frac{7}{8}$lb? *Answ.* 4 $\frac{92}{105}d.$

4. If 19$\frac{1}{5}$lb cost $\frac{9}{10}l.$ what Quantity can I have for $\frac{5}{8}s.$?
Answer, $\frac{2}{3}$lb.

5. What will $\frac{1}{2}$C wt. come to, if 6$\frac{3}{4}$ C wt. cost 21 $\frac{3}{4}l.$?
Answer, 1$l.$ 12$s.$ 2 $\frac{2}{3}d.$

6. How many lb of Pot-Ashes can I have for 12 $\frac{1}{4}d.$ If 1lb cost 1 $\frac{3}{4}d.$? *Answer*, 7lb.

7. If for 10$\frac{1}{3}s.$ I buy one hundred of Oranges; how many hundred can I have then for 105 $\frac{11}{12}s.$?
Answer, 10 $\frac{1}{4}$ hundred.

8. If 1 lb of any thing cost 5 $\frac{1}{4}s.$ what will $\frac{7}{8}$ come to?
Answer, 4$s.$ 7$\frac{1}{8}d.$

9. How much will $\frac{1}{4}$ C wt. come to at the rate of 15 $\frac{3}{4}s.$ the C wt.? *Answer*, 3$s.$ 11$\frac{1}{4}d.$

Although the Method before laid down be universally applicable, as by the foregoing Examples appeareth, yet there are other Methods more ready and accomodate in Practice in some particular Cases.

Rule I.

If the first and third Terms be Fractions and the second not, reduce the said first and third to one common Denominator; then rejecting the Denominators, I make the Numerator of the first, the first Term, and the Numerator of the third, the third Term, and work as in whole Numbers, *&c.*

Application.

10. If $\frac{5}{6}$ Yard of Linen cost 2*s*. what cost $\frac{15}{16}$ Yard at that Rate?

$$\begin{array}{r} 2)\ 6,\ 16 \\ \hline 3,\ \ 8 \\ 3 \\ \hline 24 \\ 2 \\ \hline 48 \end{array} \qquad \frac{5}{6}=\frac{40}{48} \qquad \frac{15}{16}=\frac{45}{48} \qquad \begin{array}{r} 40 \text{———} 2 \text{———} 45 \\ 2 \\ \hline 4|0)\ 9|0 \\ \hline \end{array}$$

Answ. 2*s*. 3*d*.

48 common Denominator.

11. If $\frac{1}{4}$ of a Pound of Tea cost 1*s*. 9*d*. what cost $\frac{5}{8}$ lb?
Answer, 4*s*. 4 $\frac{1}{2}$*d*.

12. If $\frac{3}{8}$ Yard cost 9*s*. 4$\frac{1}{2}$*d*. what cost $\frac{2}{3}$ Yard?
Answer, 16*s*. 8*d*.

13. If $\frac{1}{3}$ of a Pound *Troy* cost 19*s*. 6*d*. what cost $\frac{11}{12}$?
Answer, 2*l*. 13*s*. 7$\frac{1}{2}$*d*.

Rule II.

If of the first and third Terms one be 1, and the other a Fraction, put the Denominator of the Fraction instead of 1, and the Numerator in the place of the Fraction, and work the Question as in whole Numbers as before.

Application.

14. If 1 Ton of Tallow cost 35*l*. what cost $\frac{3}{4}$ of a Ton?

$$\begin{array}{r} 4 \text{———} 35 \text{———} 3 \\ 3 \\ \hline 4)\ 105 \\ \hline 26l.\ 5s. \end{array}$$

15. If 1 Ounce of silver cost 5*s.* how much cost $\frac{5}{8}$ of an Ounce? *Answer*, 3*s.* 1½*d.*
16. At 25*s. per* C wt. how much will ¾ of a C. cost? *Answer*, 18*s.* 9*d.*
17. If the Freight of a ship be 247*l.* 16*s.* 8*d.* what must *A. B.* receive for his $\frac{5}{16}$ thereof? *Answer*, 77*l.* 8*s.* 11½*d.*
18. What will 1 Yard come to, if ¾ Yard cost 18*d.*? *Answer*, 2*s.*
19. If half a Quarter of *Flanders* Lace cost 3*s.* what is that a Yard? *Answer*, 1*l.* 4*s.*

Rule III.

Of the first and third, if one be a whole Number and the other a Fraction, multiply the whole Number by the Denominator of the Fraction and work as before. Or if one be a whole Number and the other a mixed Number, bring the mixed Number to an improper Fraction and put the Numerator in the Place of the Fraction or mixed Number, and multiply the whole Number by the Denominator of the Fraction and place the Product in the room of the said whole Number.

Application.

20. If a Piece of Cambrick 15 Yards long cost 3*l.* 15*s.* what cost ½ Yard?

	Yds.		*l.*	*s.*	*Yd.*
	15	——	3	15 ——	½
	2				
			l.	*s.*	
Half Yards	30	5)	3	15	1
	6) 0 15				

Answer, 2*s.* 6*d.*

21. If a Piece of Linen containing 40 Yards cost 30*s.* what is the Price of 4⅘ Yards? *Answer*, 3*s.* 7⅕*d.*
22. If 6¾ C of Goods cost 21¾*l.* what cost 1 Ton? *Answer*, 64*l.* 8*s.* 10⅔*d.*
23. Bought a Bag of Wool, Wt. neat 5¾ C. at 9*s.* 6*d. per* Stone; what doth it amount to? *Answer*, 19*l.* 2*s.* 4½*d.*

Rule

Rule IV.

If the second Term be a Fraction likewise, the first and third being brought to one Denomination. Multiply the first by the Denominator of the second for a Divisor, and the third by the Numerator of the second for a Dividend, divide the last by the first and the Quotient is the Answer.

Application.

24. If $\frac{1}{4}$ Yard of *Flanders* Lace cost $\frac{2}{3}s.$ what cost $\frac{7}{8}$?

$\frac{1}{4}$ is $\frac{2}{8}$,

$$2 \text{ —— } \frac{2}{3} \text{ —— } 7$$

$$\begin{array}{rcr} 3 & & 2 \\ \hline 6 & \quad 6) & 14 \\ \hline \end{array}$$

Answer, $2\frac{1}{3}s.$ or $2s.$ $4d.$

25. At $\frac{5}{6}l.$ *per* Yard, how much will 42 Yards cost?
Answer, 35*l*.
26. How much will 650lb come to at $3\frac{3}{4}s.$ *per* lb?
Answer, 121*l* 17*s*. 6*d*.
27. If $\frac{4}{7}$ of an Ounce, *Avoirdupoise*. cost $10\frac{1}{2}d.$ what cost $1\frac{5}{7}$ lb? *Answer*, 8*s*. 9*d*.
28. What will $1\frac{1}{2}$ C. of Pepper come to, if $15\frac{1}{4}$ lb. cost $12\frac{3}{8}s.$ *Answer*, 6*l*. 16*s*. $3\frac{57}{61}d.$

QUESTIONS FOR EXERCISE.

1. What Part of 3*d*. is $\frac{2}{3}$ of 2*d*? *Answer*, $\frac{4}{9}$.
2. What Part is 176 of 368 *Answer*, $\frac{11}{23}$.
3. By how much must I multiply $13\frac{2}{3}$, that the Product may be $49\frac{1}{5}$? *Answer*, $3\frac{3}{5}$.
4. What differs $7\frac{3}{4}d$ from $3\frac{1}{3}s$? *Answer*, 2*s*. $8\frac{1}{4}d.$
5. What Number is that which when added to $\frac{1}{8}$, $\frac{1}{32}$ and $\frac{1}{15}$ together will make $\frac{24}{37}$? *Answer* $\frac{10097}{26664}$.
6. What Number is that, to which, if $\frac{3}{10}$ of $\frac{18}{7}$ of $\frac{141}{71}$ be added, the total may be 1? *Answer*, $\frac{3649}{7455}$.
7. A Father dying left his Son a Fortune, $\frac{3}{16}$ of which he ran out in 6 months; $\frac{2}{3}$ of the remainder held him a

Twelvemonth longer, at which Time he had bare 348*l.* left: Pray what did the Father bequeath him?

Answer, 1284*l.* 18*s.* $5\frac{1}{2}$*d.*

8. A younger Brother received 2200*l.* which was just $\frac{5}{12}$ of his elder Brother's Fortune; and $3\frac{1}{8}$ times the Elder's Money was $\frac{1}{2}$ as much again as the Father was worth: What was that? *Answer*, 11000*l.*

9. How many Stones of $1\frac{3}{4}$ Foot long, $\frac{2}{3}$ Foot broad, and $\frac{3}{4}$ Foot thick, are equal to 50 Stones of $3\frac{1}{3}$ Foot long $2\frac{1}{2}$ Foot broad, and $1\frac{1}{5}$ thick? *Answer*, $571\frac{3}{7}$.

10. A Merchant hath $\frac{3}{4}$ of a ship and sells $\frac{1}{4}$ of his Interest therein for 250*l.* I demand the Value of the whole Ship at that Rate? *Answer*, 1333*l.* 6*s.* 8*d.*

11. How much will 2 Bags of Wool come to, No. 1, Wt. $94\frac{3}{16}$ Stone; No. 2, $305\frac{7}{9}$ at 10*s.* $6\frac{2}{3}$*d.* *per* Stone; but $4\frac{2}{3}$ Stone of No. 2, are worth but $2\frac{1}{4}$ Stone of No. 1?

Answer, 127*l.* 10*s.* $4\frac{1}{8}\frac{9}{4}$*l.*

12. A Father devised $\frac{3}{8}\frac{4}{3}$ of his Estate to one of his Sons, $\frac{3}{8}\frac{4}{3}$ of the residue to another, and the surplus to his Relict for Life; the Children's Legacies were found to be 257*l.* 3*s.* 4*d.* different: What Money did he leave the Widow the use of? *Answer*, 534*l.* 2*s.* $7\frac{3}{2}\frac{3}{8}\frac{1}{9}$*d.*

13. If $\frac{3}{7}$ of $\frac{4}{5}$ of $\frac{7}{8}$ of a Ship be worth $\frac{1}{9}$ of $\frac{6}{7}$ of $\frac{1}{7}\frac{1}{3}$ of the Cargo valued at 12000*l.* what did both Ship and Cargo stand the Owners in? *Answer*, 15223*l.* 8*s.* $10\frac{3}{8}\frac{0}{1}\frac{6}{9}$*d.*

14. If a Wedge of Gold, weighing $17\frac{3}{7}$ lb, be worth $679\frac{5}{7}$*l.* what is the Value of $1\frac{3}{13}$ Grain? *Answ.* 2*d.*

15. A Man dying gave to his eldest son $\frac{2}{3}$ of $\frac{1}{4}$ of his Estate; to his second $\frac{1}{5}$ of $\frac{1}{2}$, and when he counted their Portions, the one had 40*l.* more than the other; the Remainder was given to the wife and younger Children; how much had each?

Answer, The eldest Son 100*l*; the second 60*l.*; the Wife and younger Children 440*l.*

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† 16. In the Year I wrote this, if to my Age you add
$\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{5}$, (thereof) with $\frac{1}{3}$ more,
The Number 74 will then be had.
Ingenious Youths, my Age explore.
Answer, 36 Years.

17

17. A in a ſcuffle, ſeized on $\frac{2}{3}$ of a Parcel of Sugar-Plumbs, B catched $\frac{3}{8}$ of it out of his hands, and C laid-hold on $\frac{3}{10}$ more; D ran off with all A had left, except $\frac{1}{7}$, which E afterwards ſecured ſlily for himſelf; then A and C jointly ſet upon B who, in the conflict, let fall $\frac{1}{2}$ he had, which were equally picked up by D and E.—B then kicked down C's hat, and to work they went a-new for what it contained; of which A got $\frac{1}{4}$, B $\frac{1}{3}$, D $\frac{2}{7}$, and C and E equal Shares of what was left of that Stock; D then ſtruck $\frac{3}{4}$ of what A and B laſt acquired out of their hands; they with Difficulty recovered $\frac{5}{8}$ of it in equal Shares again, but the other three carried off $\frac{1}{8}$ a piece of the ſame. Upon this they called a truce, and agreed, that the $\frac{1}{3}$ of the whole left by A at firſt ſhould be equally divided among them: How much of the Prize, after this Diſtribution, remained with each of the Competitors?

Anſwer, A got 2863—B 6335—C 2438—D 10294 E 4950.

BOOK II. PART II.

CHAP. I.

OF DECIMAL FRACTIONS.

DECIMAL Fractions are a kind of Fractions, which vary in the ſame Proportion, and are managed by the ſame Methods of Operation as whole Numbers are.

For this Purpoſe every Proper Fraction is ſuppoſed to be reducible to another whoſe Denominator ſhall be 10, 100, 1000, &c. *viz.* Unity with ſome Multitude of Cyphers annexed: And Fractions with ſuch Denominators are called *Decimal Fractions*: Such are $\frac{5}{10}$, $\frac{75}{100}$, $\frac{625}{1000}$.

As the Denominator of a Decimal Fraction is always 10, or 100, or 1000, &c. the ſaid Denominators need not be expreſſed. For the Numerators only may be made to expreſs the true value of a Decimal: for this purpoſe it is only required to write the Numerator, with a point before it, to diſtinguiſh it from a whole Number, when it conſiſts of as many Figures as the Denominator hath Cyphers annexed to Unity; ſo $\frac{5}{10}$ may be written .5; $\frac{75}{100}$, .75; $\frac{625}{1000}$, .625.

N. B. The Point prefixed is called the Separatrix.

But if the Numerator hath not so many Places, as the Denominator hath Cyphers, put as many Cyphers before it, *viz.* to the Left-hand as will make up the Defect; so write $\frac{5}{100}$ .05, $\frac{5}{1000}$ .005. And thus do these Fractions receive the Form of whole Numbers.

We may consider Unity as a fixed Point, from whence whole Numbers proceed infinitely increasing, and Decimals infinitely decreasing towards 0, as in the following

TABLE.

Millions	C. Thousands	X. Thousands	Thousands	Hundreds	Tens	Units	Tenth Parts	Hundredth Parts	Thousandth Parts	X. Thousandth Parts	C. Thousandth Parts	Millioneth Parts
7	6	5	4	3	2	1	2	3	4	5	6	7
Whole Numbers.							Decimals.					

From this Table it is manifest that

In Decimals, as well as in whole Numbers, each Figure taketh its Value by its Distance from Units Place: If it be in the first Place after Units (or the separating Point) it signifies Tenths; if in the second, Hundredths, &c. decreasing in each Place in a Tenfold Proportion.

Consequently every single Figure expressing a Decimal, hath for its Denominator 1, with as many Cyphers as its Place is Distant from Unit's Place, Thus 2 in the Table is $\frac{2}{10}$, 3 $\frac{3}{100}$ 4 $\frac{4}{1000}$, &c. And if a Decimal be expressed by several Figures, the Denominator is 1, with as many Cyphers as the lowest Figure is distant from Units Place. So 234 signifies $\frac{234}{1000}$.

A Cypher (or Cyphers) placed at the Right-hand of a Decimal Fraction, altereth not its Value, since every significant Figure continueth to possess the same Place. So .5—.50—.500 are all of the same Value.

But a Cypher or Cyphers put to the Left-hand of a Decimal, do alter its Value, every Cypher depressing it to $\frac{1}{10}$ of the Value it had before, by removing every significant Figure one Place farther from the Place of Units. So

So .5, .05, .005 all express different Decimals, *viz.* .5 $\frac{5}{10}$; .05, $\frac{5}{100}$; .005, $\frac{5}{1000}$.

Hence likewise may be observed the contrary Effect of Cyphers being annexed to whole Numbers, and Decimals: Every Cypher to the right Hand of a whole Number encreaseth its Value ten times; but Cyphers to the right Hand of a Decimal do not alter its Value. Again, Cyphers put to the left-Hand of a whole Number do not alter its Value; but every Cypher put to the left hand of a Decimal, depresseth its Value to the $\frac{1}{10}$ of what it would be without them.

So 5	is	Five		.5	is	$\frac{5}{10}$
50		Fifty		.05		$\frac{5}{100}$
500		Five Hundred		.005		$\frac{5}{1000}$
5000		Five Thousand		.0005		$\frac{5}{10000}$

It is likewise manifest from the Table, that since the Places of Decimals decrease in a tenfold Proportion from Units downwards, so they consequently increase in a tenfold Proportion from the right Hand towards the left; as the Places of whole Numbers do, for Ten Hundredth Parts make One Tenth, Ten Tenths make 1; Ten Units Ten; Ten Tens One Hundred, &c. *viz.* $\frac{10}{100}=\frac{1}{10}$. $\frac{10}{10}=1$, $1 \times 10 = 10$, which proves that Decimals are subject to the same Law of Notation and consequently of Operation, as whole Numbers are.

Decimal Fractions of unequal Denominators are reduced to one common Denominator, when they are annexed to the right Hand of those which have fewer Places, as many Cyphers as make them equal in Places with that which hath most. So these Decimals .5, .04, .125, may be reduced to the Decimals .500, .040 and .125, which have all 1000 for their Denominator.

Of Decimals, that is the greatest, whose highest Figure is greatest, whether they consist of an equal or unequal Number of Places: Thus, .575 is greater than .395 and .5 greater than .395, for if it be reduced to the same Denominator with .395, it will be .500, which is manifestly the greater.

A mixt Number, *viz* a whole Number with a Decimal annexed is equal to an improper Fraction, whose Numerator is all the Figures of the mixed Number, taken as one whole Number and the Denominator that of the Decimal Part. So 32.405 is equal to $\frac{32405}{1000}$, as is manifest from the Method laid down to reduce a mixt Number to an improper

Fraction

Fraction for 32 the Integral Part being multiplied by 1000 the Denominator of the Fractional Part produces 32000, to which adding 405, the Numerator of the Fractional Part, the Sum 32405 is the Numerator to 1000 for an improper Fraction equal to the given mixed Number.

$$\begin{array}{r} 32000 \\ 405 \\ \hline 32405 \end{array}$$

CHAP. II.

REDUCTION OF DECIMALS.

To reduce a Vulgar Fraction to a Decimal.

TO the Numerator annex a competent Number of Cyphers; then divide by the Denominator and the Quotient will be the Decimal required. But *note* that the Decimal must always consist of as many Places as there are Cyphers annexed to the Numerator.

Examples.

1. What Decimal is equal to $\frac{1}{4}$?
2. Reduce $\frac{1}{2}$ to a Decimal equal thereto?
3. What is the Decimal equal to $\frac{3}{4}$?
4. What is the Decimal equal to $\frac{1}{5}$?
5. What Decimal is equal to $\frac{11}{16}$?
6. Reduce $\frac{12}{25}$ to a Decimal.
7. What Decimal is equal to $\frac{21}{32}$?
8. Bring $\frac{17}{26}$ to a Decimal.

If the Quotient doth not consist of as many Figures as there are Cyphers annexed, &c. make up the Deficiency by putting Cyphers to the left Hand of the said Quotient.

Application.

$$\begin{array}{l} 5|0)\ 2.0|0 \\ \hline \quad .04 \end{array}$$

Let $\frac{2}{50}$ be reduced to a Decimal. I annex two Cyphers, and the Quotient results 4, which being one Figure less than the Cyphers annexed, I put a Cypher to the left Hand to make up the Deficiency.

What

9. What Decimal is equal to $\frac{3}{32}$?
10. What Decimal is equal to $\frac{1}{64}$?
11. What Decimal is equal to $\frac{5}{128}$?
12. Reduce $\frac{1}{3}$ to a Decimal? *Answer*, .33333 &c.
13. Bring $\frac{11}{15}$ to a Decimal? —— .73333
14. What Decimal is equal to $\frac{13}{15}$? —— .86666
15. Reduce $\frac{3}{11}$ to a Decimal? —— .272727
16. Reduce $\frac{1}{27}$ to a Decimal? —— .037037
17. Reduce $\frac{11}{14}$ to a Decimal? —— .785785
18. Bring $\frac{1}{13}$ to a Decimal? —— .07692307&c.
19. Reduce $\frac{5}{26}$ to a Decimal? —— .19230769&c.
20. Bring $\frac{4}{7}$ to a Decimal? —— .57142857&c.

Problem II.

To reduce the Denominations of Money, Weights and Measures to Decimals.

Bring the given Denominations first to a Vulgar Fraction, and reduce said Vulgar Fraction to a Decimal.

21. Reduce 11*s.* to the Decimal of a Pound? *Answ.* .55
22. What Decimal is equal to 8*s.* the whole being 1*l.* } *Answ.* .4
23. Reduce 15*s.* to the Decimal of a Pound? *Answ* .75
24. Reduce 8*d* to the Decimal of a Shilling? *Ans.* 66666
25. Reduce 8*d.* to the Decimal of a Pound? *Ans.* .03333
26. What is the Decimal of 5 Ounces, 1 lb *Troy-wt.* being the Integer? *Answ.* } .41666
27. What Decimal of a C.wt. is 6lb? *Answ.* .0535714

Numbers

Numbers of divers Denominations.

Bring 17*s.* 6*d.* to the Decimal of a Pound.

```
     12
    ----
    21|0 |              s.  d.         Or
 3] ---- |7/8 equal to  17  6    24|0] 210.00|0 [.875
    24|0 |                            192 . .
                                      -----
                                       180
  8] 7 000                             168
  --------                            -----
    .875                               120
                                       120
                                      -----
```

Or thus,

Let 17*s.* 6*d.* be again given to be reduced to the Decimal of a Pound:

```
12] 6.0
-------
2|0] 17.50|0
-------
.875
```

Annex a Cypher to 6*d.* and divide by 12, [the Pence in a Shilling] the Quotient is .5, to which prefix 17, and divide 17.5 by 20, [the Shillings in the Pound] adding Cyphers till the Quotient results without Remainder, and the Decimal required is found ,875 as before.

28. What Decimal of a Yard is equal to 3*qrs.* 2*Na.*?
Answ. .875
29. Bring 1 *Hhd.* 21 *Gal.* 4 *Pts.* to the Decimal of a Tun?
Answ. .335317
30. What Decimal of a Pound is equal to 6*oz.* 14 *dwt.* 10*gr.* *Troy*? *Answ.* .56006944
31. What Decimal of a Pound is 17*s.* $4\frac{1}{2}$*d.*? *Ans.* .86875
32. What Decimal of 1 C.wt. is equal to 3 *qrs.* 21 lb? *Answer,* .9375
33-34. What Decimal of a Shilling, and of a Pound is $9\frac{3}{4}$*d*? *Answer,* .8125*s.* and .040625*l.*

But

But the Decimals of Sterling Money may be wrote in one Line by the following.

Rule.

1. Write half of the greateſt even Number in the Place of Shillings, for the firſt Decimal Figure.

2. Let the Farthings in the given Pence and Farthings poſſeſs the ſecond and third Decimal Places; obſerving to encreaſe the Place of Hundreds by 5, if the Shillings are odd: And to encreaſe the Thouſands by as many Units as there are Times 24 in the Pence and Farthings.

3. If more than three Places are needful, then divide half the Number of Farthings in the Pence and Farthings, [rejecting 24 or 6*d.* if there is one] by 12, the Quotient written after three Places before found will give the Decimal required.

Examples.

		s.	*d.*
1	————	10	8
2	————	13	$10\frac{1}{2}$
3	————	15	$9\frac{3}{4}$
4	————	19	$11\frac{1}{4}$
5	————	1	$10\frac{1}{4}$
6	————	0	$8\frac{3}{4}$
7	————	0	$2\frac{1}{2}$
8	————	0	$0\frac{3}{4}$

Problem III.

To find the Value of a Decimal of a Superior Denomination in the known Parts of the leſſer Denomination.

Multiply the Decimal by that Number which one of the higher Denomination contains of the leſſer, and from the Product point off as many Places to the right Hand as there are in the given Decimal, and the Figures on the left of the ſeparating Point will be the Number of the ſaid leſſer Denomination, and thoſe on the right a Decimal thereof, of which find the Value as before; and ſo from Denomination to Denomination till the loweſt be arrived at, or till the figures cut off be all Cyphers,

Application.

Application.

What is the Value of .875*l.*?

I multiply the Decimal .875 by 20, [the Shillings in a Pound] and find the Produƈt 17.500, from which I point off the three loweſt Figures [being the Number in the given Decimal] by the Separatrix, and ſo it ſtands 17*s.* .500, which 500 is a new Decimal Part of a Shilling which I multiply by 12 [the Pence in a Shilling] and find its Value 6*d.*; and therefore the Value of the given Decimal is 17*s.* 6*d.*

	.875
	20
s.	17.500
	12
d.	6.000
Anſw.	17*s.* 6*d.*

35. What is the Value of .75*l.*? *Anſw.* 15*s.*

36. What is the Value of .66666*s.*? *Anſw.* 8*d.**

37. What is the Value of .033333*l.*? *Anſw* 8*d.*

38. What is the Value of .875 of a Yard? *Anſ.* 3*qrs.* 2*N.*

39. What is the Value of .335317 of a Tun? *Anſw.* 1 *Hhd.* 21 *gal.* 4 *pts.*

40. What is the Value of .5600944 of a ℔ *Troy*? *Anſw.* 6*oz.* 14*dwt.* 10*gr.*

41. What is the Value of .86875*l.*? *Anſw* 17*s.* 4½*d.*

42. What is the Value of .9375 of a C.wt.? *Anſw.* 3*qrs.* 21 ℔.

But the Value of the Decimal Part of a Pound Sterling may be expreſſed in one Line thus:

Double the firſt Figure, or Primes for Shillings, and if the ſecond be 5, or exceed 5, reckon one Shilling more; the Figures in the ſecond and third Place [rejeƈting 5 from the ſecond] are ſo many Farthings, abating 1 for every 24.

* *Note*, where the ſeveral Figures cut off are 9, the Value of the Decimal is one more than the Figure or Figures on the left Hand of the Separatrix.

Application.

Application.

Let it be required again to find the Value of .875*l*.

.875	I ſay 8 and 8 is 16*s*. and 1 [for 5 in 7] makes 17*s*. Then 5 rejected out of 7 leaves 2 in the ſecond Place which with the third, account 25 Farthings, and abating 1, [being above 24] there remain 24 Farthings or 6*d*.
s. 17 6	

Examples.

43. Find the Value of .92763*l*. *Anſw.* 18*s*. 6¼*d*.
44. ——————— .87638*l*.
45. ——————— .09937*l*.
46. ——————— .0428*l*.
47. ——————— .0095*l*

C H A P. III.

ADDITION and SUBTRACTION of Decimals.

TO place the Numbers to be added or ſubtracted.

In placing the Numbers to be added or ſubtracted, whether mixt or pure Decimals, take Care to place the Figures of the ſame local Value directly underneath each other [as in pure whole Numbers], *viz* Hundredths under Hundredths, Tenths under Tenths, Units under Units, Tens under Tens, &c. So will all the ſeparating Points be in one perpendicular Row, but this may, or may not happen to the extreme Figures of mixt Numbers either to the right Hand or to the left.

Rule.

To add or ſubtract Decimals or mixt Numbers.

Add or ſubtract them as if they were pure whole Numbers and from the Sum or difference point off ſo many Decimal Parts as are the moſt in any of the given Numbers.

Examples.

Examples.

[1]	[2]	[3]
25.854	.5	.61271
34.578	.666	.8752
9.076	.75	.012
13.907	.4444	.875
45.070	.7	.05

[4]	[5]	[6]
42.5	178.025	32.375
65.666	4.1385	487.25
96.875	.71683	366.66666
25.9	.03675	296.078754
240.933	.825	430.5382427
817.35	.6125	608.3075
23.275	.333333	

[7] Add together .7426, .846, 7.612, 5.5 and 12.0875

[8] Add 753.0375—— 246.38246—— 9724.28352—— 67482.063750—— 724.00003718—— and 378.2375 together.

Examples.

	[1] *Years.*	[2] *Days.*	[3] *Weeks.*	[4] *Hours.*
From	1081.761	712.10009	127.19	12.
Take	10.00012	7.121	121.	.12

	[5] *Minutes.*	[6] *Months.*	[7] *Ells.*	[8] *Tuns.*
From	174.1	6100.	.172618	761.8109
Take	1.471	6.109	.0000148	18.9112

CHAP. IV.

MULTIPLICATION of DECIMALS.

WHether the given Numbers be mixt Numbers or pure Decimals, multiply them as if they were all pure whole Numbers and when the Product is found,

Point

Point off so many Decimal Parts or Places, as there are in both the Multiplicand and Multiplier, accounted together.

Examples.

[1]	[2]	[3]	[4]
3.024	32.12	78.546	.5745
2.23	24.3	24.36	.06757

[5]	[6]	[7]
37.025	674.4375	92.075
5.275	27.368	3.00375

N. B. It will sometimes fall out that in multiplying Decimals by Decimals there will not be so many Figures in the Product, as the Rule requires Decimal Places; in that Case supply the Defect by prefixing as many Cyphers as Places are wanting.

[8]	[9]	[10]	[11]
.2365	.0347	.857	.007853
.2456	.0236	.025	.035
.05808440			

[12]	[13]	[14]
.03246	.83649	3.141592
.02364	.03687	52.7438
.0007673544	.0308413863	165.6995001296

To multiply by 10, 100, 1000, &c. remove the seperating Point as many Places to the right Hand as the Multiplier hath Cyphers.

$$\text{So } \ .125 \left.\vphantom{\begin{array}{l}1\\1\\1\end{array}}\right\} \text{multip. by} \left\{\begin{array}{l}10\\100\\1000\end{array}\right\} \text{makes} \left\{\begin{array}{l}.125\\12.5\\125.\end{array}\right.$$

For .125 × 10 is 1.250, &c.

To

To multiply finite or approximate Decimals, ſo that the Product ſhall conſiſt of no more than a determinate Number of Places.

Rule.

Under that Place in the Multiplicand, thought neceſſary to be retained in the Product, write the Units Place of the Multiplier, and invert the Order of all its other Places; that is, write the Decimals on the left, and the Integers [if any] on the right; in multiplying, omit thoſe Places in the Multiplicand which ſtand to the right of the Figure multiplied by, and let the right Hand Place of every Line ſtand under each other.

In each Line let the loweſt Place be encreaſed by the Carriage which would ariſe from the omitted Places, carrying 1 from 5 to 15, 2 from 15 to 25, 3 from 25 to 35, &c. inſtead of carrying 1 for every 10; and the Sum of theſe Lines will give a Product generally exact.

Examples.

Multiply 384.672158 by 36.8345

Now ſeeing there would be ten Decimal Places in the Product whereof the greateſt part are unneceſſary; therefore to keep only four Decimal Places in the Product,

```
384.672158
   5438.63
──────────────
115401647 -
 23080329 - -
  3077377 - - -
   115402 - - - -
    15387 - - - - -
     1923 - - - - - -
──────────────
14169.2065
```

[15] Multiply 3.141592 by 52.7438 ſo as to have only four Decimal Places in the Product? *Anſw.* 165.6995.

CHAP. V.

DIVISION OF *DECIMALS.*

DECIMALS and mixt Numbers are in effect divided as whole Numbers, as ſhall be ſet forth in the ſundry Caſes following:

I. General

I. General Rule *for pointing the Quotient.*

The Places of Decimal Parts in the Divisor and Quotient, counted together, must be always equal to those of the Dividend, therefore point off in the Quotient as many Figures as are the Excess of Decimal Places in the Dividend above those in the Divisor.

Application.

Let B Divide A and find the Quotient C. now first let B have two Decimal Places and A six, the Excess of six above two is four the Decimal Places to be pointed off in C; or if B hath two and A four; the Excess is two to be pointed off in C.

```
  B       A        C
5.73) 2.580219 (.4503
        2292
        ----
        2882
        2865
        ----
         1719
         1719
  B       A        C
5.73) 258.0219 (45.03
```

Case 1. When the Places of Decimals in the Dividend and Divisor are equal, the Quotient will be an unmixed whole Number.

Examples.

[1] 8.45) 295.75 (

[2] .0078) .4368 (

[3] .7563) 59062.4922 (

Case 2. When the Places of Decimals in the Dividend are most, cut off the Excess for Decimal Parts in the Quotient.

[4] 24.3) 780.516 (

[5] .436) 34246.056 (

[6] .534) .30438 (

Case 3. When there are not so many Places of Decimals in the Dividend as the Divisor, annex Cyphers to the Dividend to make them equal; then will the Quotient be an unmixed whole Number.

Case 4. If after the Division is finished, there are not as many Figures in the Quotient, as there ought to be Decimal Places, [by the general Rule] supply the Defect by prefixing as many Cyphers as there are Places wanting.

[7]

[7] .957) 7.25406([8] .525) .0007875(
[9] .43) .13975([10] 45.) 3.9375(
[11] .00875) 38.075(

Note. When Decimals or whole Numbers are to be divided by 10, 100, 1000, &c. *viz.* Unity with Cyphers, it is performed by removing the Separatrix in the Dividend so many Places towards the left Hand, as there are Cyphers in the Divisor.

Examples.

10	Dividing	5784	the Qu. is	578.4
100				57.84
1000				5.784
10000				.5784

When the Divisor doth not measure the Dividend, we may approach as near the Truth as we please by annexing Cyphers continually, to the Dividend, or the Remainder: But six or seven Places of Decimals are generally esteemed sufficient, for the Quotient Differs from the Truth by less than $\frac{1}{1000000}$ of a Unit.

[12] .6252) 14250.([13] 48.25) 374.86(
[14] 52.125) 2.34([15] .056) 82.(

Division may be contracted as follows:

Rule.

Let each Remainder be a new Dividend, and for each such new Dividend point off one Figure from the right Hand of the Divisor, observing at each Multiplication to have Respect to the increase of the Figures so cut off, as in *Multiplication.*

Examples.

Examples.

```
384.672158) 14169.2066238510 (36.8345
     ----- 1154016474
           ----------
            262904188 -
            230803295 -
            ---------
             32100893 - -
             30773772 - -
             --------
              1327121 - - -
              1154016 - - -
              -------
               173105 - - - -
               153869 - - - -
               ------
                19236 - - - - -
                19233 - - - - -
                -----
```

[16] 9.365407) 87.076326 (9.297655

THE SINGLE RULE OF THREE IN DECIMALS.

REDUCE the Fractional Parts into Decimals of the highest Name mentioned, then state the Question and proceed as in the Rule of Three Direct, observing to point off the Decimal Places as has been taught in Multiplication and Division of Decimals.

1. Suppose I give 6*s.* 3*d.* for $4\frac{3}{4}$ Yards of Cloth; what will $48\frac{1}{2}$ Yards of the same come to at that Rate?

Answ. 3*l.* .1907 or 3*l.* 3*s.* $9\frac{3}{4}$*d.*

2. If $2\frac{1}{2}$ lb. of Tea cost 1*l.* 5*s.* what will $14\frac{3}{4}$ lb. come to at the same Rate?

Answ. 7*l.* .375 or 7*l.* 7*s.* 6*d.*

3. If

3. If 1 lb. of Sugar cost 11 ¾*d.* what will 4 hhds. each weighing Nett 4 Cwt. 2*qrs.* 14 lb. cost at the same Rate?

Answer, 101*l.* 4417 or 101*l.* 8*s.* 10*d.*

4. A Grocer buys 4 Chests of Tea, each weighing Net 2 *Cw.* 3 *qrs.* 14 lb for 906. 10*s.* what Rate did he give *per* lb? *Answer,* 7038 or 14*s.* ¾*d.*

5. An Oilman Bought 4 Tuns 201½ Gallons of Florence Oil for 240*l.* 16*s.* 6*d.* but by Misfortune it chanced to leak out 24½ Gallons: I desire to know at what he may sell the remainder *per* Gallon, to be no loser?

Answer, 20322 or 4*s.* 0¾*d.*

CHAP. VI.

Of Circulating Decimals.

THE following Method of managing circulating Decimals, being taken Notice of in few Books of Arithmetick that I have seen. I chose to deliver it by itself, detached from the common Doctrine of Decimals, before laid down.

And first it will be proper to shew how to multiply and divide by 9, 99, 999, &c. in a contracted and very easy way.

I. To multiply by 9, 99, 999, &c.

Write as many Cyphers as there are Nines in the Multiplier to the right Hand of the Multiplicand, and from the Result subtract the Multiplicand and the Remainder will be the Product.

1. Let it be required to multiply 456 by 9, &c.

One Cypher added to 456 makes $4560 = 456 \times 10$

From which subtract the Multiplic. $456 = 456 \times 1$

The Remainder is the Product $4104 = 456 \times 10 - 1$

2. Two

2. Two Cyphers added to 456 make $45600 = 456 \times 100$
From which subtract — — $456 = 456 \times 1$

The Remainder is the Product $44144 = 456 \times 100\text{-}1$

468 by $9 = 4212$, $3726 \times 99 = 368874$, $7568 \times 999 = 7560432$

II. To Divide by 9, 99, 999, *&c.*
Divide the given dividend into Periods of as many Places as there are 9's in the Divisor, beginning from the left Hand, and annex as many Cyphers to the right Hand of the Number as may be wanted to complete a Period.

Then write the Figures of the left-Hand Period, under the next to the right Hand, add these togther, and Place their Sum under the third Period, (if the Sum amount to more Figures than are in a Period, the highest will of course fall under the lowest Place of the second Period.) In like Manner add this Sum to the Period, and place the Result under the fourth and so on: Lastly, under the last Figures place that Figure, which would have been placed there (if any) suppose the Work had been to proceed a Period farther.

Add them all together; and cancel as many Figures as there were Cyphers annexed to the Dividend; then from the Figures that remain, cut off with a Comma, from the right Hand toward the left, as many Figures as the Divisor contains Nines; so shall the Figures to the left of the Comma be the Quotient, and those on the right the Remainder, which if it be all Nines, add 1 to the Quotient.

Application.

Let it be required to divide 87325 by 99?

The Dividend with a Cypher to make 3 Periods,	87.32.50
The first Period written under the second, —	87.
The Sum of 87 and 32 is - - - - - - - - - - —	1.19
	1
	882.070

Under the last Place I set 1, because if 50 and 119 were added, the one would be so placed, the whole Sum is 882.07, the last o being cancelled for o added, *i. e.* 882 the Quotient, and 7 Remainder.

Those Decimals which are produced from Vulgar Fractions whose Denominators measure their Numerators with Cyphers annexed are called finite or terminate Decimals, because they consist of a determinate Number of Places.

Decimals, (produced from Vulgar Fractions, whose Denominators do not measure their Numerators) in which a Figure is repeated continually, or in which the same Figures circulate continually, are called *Circulating Decimals*, and the circulating Figures are called *Repetends*, and if one Figure only repeat, it is called a *Single Repetend*, as .1111. .3333.

To avoid the Trouble of writing down unnecessary Figures, a single Repetend is denoted by a point over the repeating Figure, *viz.* the Decimal .11111 is expressed by $.\dot{1}$, 3333 by $.\dot{3}$

If other Figures rise before the repeating Figure, as $.1\dot{6}=\frac{1}{6}$ .0833, or $.083\dot{3}=\frac{1}{12}$; $.0\dot{6}=\frac{1}{15}$; such Decimals are called *mixed single Repetends.*

Such as have Figures circulating alternately, or every third, fourth, &c. the same, are called *compound Repetends.* such as 410101, ,123123123.

And if other Figures arise before the Figures which circulate, then the Decimal is called a *mixt compound Repetend.*

Note, Mixt Repetends, single or compound, may be called *mixt Circulates.*

Compound Repetends are distinguished by a Point over the first and last repeating Figure: Thus, .010101 may be written $.\dot{0}\dot{1}$, and .123123123 $.\dot{1}2\dot{3}$. .15656, $.1\dot{5}\dot{6}$.

As in multiplying and dividing by these imperfect Decimals, it requires frequently that the Decimal must be extended to a pretty large Number of Places to prevent a very considerable Error resulting from their imperfection; to remedy this, and to make the Result perfect with less Trouble, it will be useful to consider their Generation.

Now

Now as 9 in 10 is contained once and one remains, Unity with Cyphers annexed being divided by 9 *ad infinitum*, the Quotient Figures will still be 1, *i. e.* $\frac{1}{9}$, which being reduced to a Decimal, will produce the circulating Decimal $.\dot{1}$: and since $.\dot{1}$ is the Decimal equivalent to $\frac{1}{9}$ $.\dot{2}$ will be equal to $\frac{2}{9}$; $.\dot{3}$ to $(\frac{3}{9}=)$ $\frac{1}{3}$; $.\dot{4}$ to $\frac{4}{9}$; $.\dot{5}$ to $\frac{5}{9}$; $.\dot{6}$ to $(\frac{6}{9}=)$ $\frac{2}{3}$; $.\dot{7}$ to $\frac{7}{9}$; $.\dot{8}$ to $\frac{8}{9}$; and $.\dot{9}$ to $(\frac{9}{9}=\frac{1}{1}=)$ 1.

Therefore every single Repetend is equal to a Vulgar Fraction whose Numerator is the repeating Figure and Denominator 9.

```
99) 1.0000 (.0101
    99
    ——
     100
      99
     ———
       1, &c.

999) 1.000000 (.001001
     999
     ———
     1000
```

Again, $\frac{1}{99}$ being reduced to a Decimal makes .010101, &c. and $\frac{1}{999}$ makes .001001001, &c. or $\frac{1}{99}=.\dot{0}\dot{1}$. $\frac{1}{999}=.\dot{0}0\dot{1}$; now every compound repetend of two Figures will be some Multiple of $.\dot{0}\dot{1}$ and the same Multiple of $\frac{1}{99}$ the Vulgar Fraction equal thereto, that is the Vulgar Fraction whose Numerator is the two repeating Figures, and the Denominator 99. That is $\frac{1}{99}$; $=.\dot{0}\dot{1}$; $\frac{2}{99}$; $=.\dot{0}\dot{2}$ $\frac{3}{99}=(\frac{1}{33}=)$ $.\dot{0}\dot{3}$; $\frac{9}{99}=$ $(\frac{1}{11}=)$ $.\dot{0}\dot{9}$, $\frac{27}{99}=(\frac{3}{11}=)$ $.\dot{2}\dot{7}$

In like Manner every compound Repetend of three Figures is shewn to be produced from a Vulgar Fraction, whose Numerator is the three repeating Figures, and Denominator 999.

And so universally, we may conceive that a Decimal Fraction, consisting only of a Repetend, is equal to a Vulgar Fraction whose Numerator is that Repetend, and the Denominator a Number consisting of as many Nines; as there are Places in the Repetend.

Next to find a Vulgar Fraction equal to a mixt Circulate, consider the next Circulate as divisible into its finite and circulating

culating Parts, *viz.* the mixt Circulate $.1\dot{6}$ divisible into the finite Decimal $.1$, and the Repetend $\dot{6}$; $.08\dot{3}$ into $.08$ and $.\dot{3}$; and $.46\dot{2}\dot{3}$ into $.46$ and $.\dot{2}\dot{3}$.

Now $.1\dot{6}$ being thus divided into the Parts $.1$ and $\dot{6}$, the Vulgar Fraction $=$ $.1$ is $\frac{1}{10}$ and the Vulgar Fraction $= \dot{6}$ is $\frac{6}{9}$ provided it were a pure Circulate, that is, provided the Circulation began immediately after Units Place; but as it begins after the Place of tenth Parts, it is $\frac{6}{9}$ of 1 of the preceding Place, *viz.* $\frac{6}{9}$ of $\frac{1}{10}$ *i. e.* $\frac{6}{90}$. So the Vulgar Fraction $= .1\dot{6}$ is $\frac{1}{10} + \frac{6}{90} = \frac{9}{90} + \frac{6}{90} = \frac{15}{90}$.

Again, in $.08\dot{3}$ $.08 = \frac{8}{100}$ and $3 = \frac{3}{9}$ of 1 of the preceding Place, *viz.* $\frac{6}{9}$ of $\frac{1}{100} = \frac{3}{900}$. So likewise $.08\dot{3} = \frac{8}{100} + \frac{3}{900} = \frac{72}{900} + \frac{3}{900} = \frac{75}{900}$.

And, $.46\dot{2}\dot{3}$ may be divided into $\frac{46}{100}$ and $\frac{23}{99}$ of $\frac{1}{100} = \frac{23}{9900}$. So the Vulgar Fraction $= .46\dot{2}\dot{3}$ is $\frac{46}{100} + \frac{23}{9900} = \frac{4554}{9900} + \frac{23}{9900} = \frac{4577}{9900}$.

To reduce a mixt Circulate to a Vulgar Fraction equivalent thereto.

Rule.

From the given mixt Circulate deduct the finite Part for a Numerator. And the Denominator of the Repetend, with as many Cyphers annexed as there are Places in the finite Part of the Decimal, is the Denominator.

A mixt Number whose fractional Part is either a pure or mixt Circulate, is reduced to an improper Fraction by the same Rule, as will appear by the following

Examples.

1. Reduce $36.\dot{7}$ to a Vulgar Fraction.

From 36.7
Take $36.$

$$\frac{331}{9}$$

For $36\frac{7}{9} = \frac{36\times9+7}{9}$ *i. e.* $\frac{467-36}{9}$

Reduce

2. Reduce $3.\dot{8}4\dot{2}$ to a Vulgar Fraction.

Answer, $\frac{3839}{999}$.

3. Reduce $57.\dot{7}$ to a Vulgar Fraction.

Answer, $\frac{520}{9}$.

4. Reduce $4275.\dot{8}\dot{4}$ to a Vulgar Fraction.

Answer, [illegible].

Those Repetends which consist of the same Number of Places are called *similar*, thus $.\dot{1}2\dot{3}$ and $.73\dot{5}1\dot{4}$ are similar Repetends.

Similar Repetends which begin at the same Place are said to be *conterminous*.

A single Repetend may put on the form of a compound Repetend without altering its Value, thus $.\dot{4}$ may be written $.\dot{4}\dot{4}$, or $.\dot{4}4\dot{4}$; or $.\dot{4}44\dot{4}$ for $\frac{4}{9}=\frac{44}{99}=\frac{444}{999}=\frac{4444}{9999}$.

Hence any given Repetend may put on the form of another Repetend, if the Number of repeating Figures in the latter be a Multiple of the Number of repeating Figures in the former; thus the Repetend $.\dot{4}\dot{5}$ may receive the Forms of Repetends consisting of 4. 6, 8, &c. Figures. *i. e.* $.\dot{4}\dot{5} = .\dot{4}54\dot{5} = .\dot{4}5454\dot{5}$ &c.

Any two or more dissimilar Repetends may be made similar by transforming them into other Repetends, which shall consist of as many Figures as the least common Multiple of the several Number of Places found in all the Repetends, contains Units.

Example I.

Dissimilar	Made Similar
$0,\dot{7}$	$0,\dot{7}\dot{7}$
$0,\dot{5}\dot{4}$	$0,\dot{5}\dot{4}$

Example II.

Dissimilar	Made Similar
$0,\dot{4}7\dot{5}$	$0,\dot{4}7547\dot{5}$
$0,3\dot{2}\dot{4}$	$0,3\dot{2}4242\dot{4}$
$0,\dot{5}\dot{9}$	$0,\dot{5}9595\dot{9}$
$0,32\dot{7}$	$0,32\dot{7}7777\dot{7}$
$0,\dot{1}$	$0,\dot{1}1111\dot{1}$

In the last Example 6 is the least common Multiple and therefore the similar Repetends must each consist of six Places.

A pure Repetend may put on the form of a mixt Repetend, thus, 0, .45 may be written 0,4545 or 0.45454. For $.454 = \frac{4}{10} + \frac{54}{99}$ of $\frac{1}{10} = \frac{4}{10} + \frac{54}{990}, = \frac{396}{990} + \frac{54}{990} = \frac{450}{990} = \frac{45}{99}$, &c.

Hence any two or more similar Repetends may be made conterminous, *i. e.* may begin at the same Place.

Examples.

Make 0, 406, and 0, 73514 conterminous.

This will be performed by making 0, 406 put on the same Form with 0, 73514, *viz.* that of a mixt Repetend having two finite Places, thus, .40640.

Example. II.

Similar Repetends	Made conterminous
0, 475475	0, 47547547
0, 3242424	0, 32424242
0, 595959	0, 59595959
0, 3277777	0, 32777777
0, 111111	0, 11111111

CHAP. VII.

ADDITION OF CIRCULATING DECIMALS.

To add Decimals which have single Repetends.

Rule.

MAKE the Repetends conterminous; then add up the right-Hand Column, and carry 1 for every 9 in the Sum, and the Overplus above the Nines put down as a Repetend in that Place, the rest of the Work, is the same as in *Addition of finite Decimals.*

Application.

Application.

Numbers proposed	Made conterminate.
2, 3	2, 33
2, 7	2, 77
4, 76	4, 76
0, 3	0, 33
5, 8	5, 80
4, 73	4, 73
	0, 74

In this Example the Sum of the Right-hand Figures is 22, the 9's in 22 is twice 9=18 and 4 over, I put down 4 and carry 2: The Reason is evident.

Other Examples.

[2]	[3]	[4]
4, 724	3, 04	25 .3
28,	8, 456	18 .04
3,	23,	3,
25, 26	0, 248	29, 123
18, 7	33. 8	16, 6
5	0, 8	18, 02

To add Decimals which have compound Repetends.

Rule.

Make the Repetends similar, and conterminous (and add the Decimals;) then to the Right-Hand Figure of the Sum add as many Units as are carried from that Column of Figures, wherein all the Repetends begin together; Lastly point off for a Repetend, as many Places as were so in the Numbers added together.

Numbers proposed	Made similar and conterminous
162	162, 162162
2, 93	2, 939393
172	172, 222222
3. 769230	3, 769230
5,	5. 000000
	346, 093007
	2
	346. 093009

Having made the given Repetends similar and conterminous, I add the Decimals together, and find the Column where the Repetends begin together amounts to 20, wherefore I must carry 2, which I add to the last Figure of the Sum and find the Repetend .093009

Reaſon.

By making the Repetends ſimilar and conterminous their Value is not altered, but the Decimals properly completed; (being as it were reduced all to the ſame Denomination) next the reaſon why we add to the loweſt Figure the Number which is carried from the Column, wherein all the Repetends begin together, is becauſe if the Circulation were continued the very ſame Figures would be repeated in the next ſucceeding Column, and conſequently the Sum would be the ſame, and the ſame Number to be carried to that which is now the loweſt Place.

Other Examples.

[5]	[6]	[7]
$134.\dot{0}\dot{9}$	$67.3\dot{4}\dot{5}$	267.3456
$97.2\dot{6}$	$8.\dot{6}2\dot{1}$	$33.\dot{8}$
$99.08\dot{3}$	$0.\dot{2}\dot{4}$	$0.6\dot{7}\dot{2}$
$1.\dot{5}$	$0.\dot{8}$	$44.8\dot{7}2\dot{5}$
$0.\dot{8}1\dot{4}$	75.75	$27.\dot{3}\dot{9}$

CHAP. VIII.

SUBTRACTION OF CIRCULATING DECIMALS.

Rule.

MAKE the Repetends ſimilar and conterminous, and ſubtract them as finite Decimals, obſerving only when the Repetend of the Number to be ſubtracted is greater than the Repetend it is to be ſubtracted from, the Right-hand Figure of the Remainder muſt be made leſs by 1.

Note, The Repetend in the Remainder will conſiſt of as many Places as thoſe of the other two Numbers.

Example I.

		Made conterminous,
[1] From	$110, \dot{6}$	$110, 6666\dot{6}$
Take	$94, 1458\dot{3}$	$94, 1458\dot{3}$
		$16, 5208\dot{3}$

Examples

Example II.

	Made conterminous
[2] From $5,0\dot{3}$	$5.033\dot{3}$
Take $3,041\dot{6}$	$3.041\dot{6}$
	$1.991\dot{6}$

Reason.

Why 1 must be subtracted from the Right hand Figure of the Remainder (*per* Rule). By subtracting the Repetend as a finite Decimal, instead of adding the common Denominator of the Repetends, 9, 99, &c. to the upper Repetend (when it is less) I add 10, 100, &c. which is always 1 more than the real common Denominator whereby the Remainder results 1 too much; wherefore I deduct that 1 from the Remainder.

[3]	[4]	[5]	[6]
$24.3\dot{8}\dot{4}$	$.\dot{7}4\dot{2}$	$6.\dot{5}7142\dot{8}$	$10.\dot{5}$
9.072	$.\dot{4}1\dot{8}$	$3.\dot{6}42\dot{8}$	$3.4\dot{5}$

CHAP. IX.

MULTIPLICATION OF CIRCULATING DECIMALS.

To multiply a finite Decimal by a Circulate.

REDUCE the Circulate to its equivalent Vulgar Fraction, and multiply the finite Decimal thereby.

Application.

1. Multiply 48.734 by $0.0\dot{4}$

$$\begin{array}{r} 48.734 \\ 4 \\ \hline \end{array} \qquad .0\dot{4} = \tfrac{4}{90}$$

$$90 \left\} \begin{array}{r} 10 \\ 9 \end{array} \left\{ \begin{array}{l} 194.936 \\ 19.4936 \text{ Quot.} \end{array} \right. \right.$$

Answer, $2.1659\dot{5}$ *Note* 5, the Remainder being $\frac{5}{9}$ is a Circulate.

2. Multiply $48.7\dot{5}$ by 4. *Answer*, $195.0\dot{2}$

3. —— $8.4\dot{7}$ by .68 *Answer*, $5.764\dot{8}$

4. Multiply $58.7\dot{6}4\dot{5}$ by 7.

From 58.7645
Take 587

$\frac{587058}{9990} = 58.7\dot{6}4\dot{5}$, 9990

$$\begin{array}{r} 587058 \\ 7 \\ \hline 41.0940.6 = 10 \\ 999)410.940.600 \\ 410.350 \\ 1.\quad 1 \\ \hline 10)4103.519 \\ \hline 410.351\dot{9} \end{array}$$

5. Multiply 48.76 by $0.1\dot{3}4\dot{5}$ *Answer*, $6.559\dot{9}0\dot{3}$

6. Multiply $65.7\dot{2}\dot{3}$ by 4.6. *Answer*, $302.32\dot{6}\dot{8}$

To multiply a Circulate by a Circulate.

Reduce them both to their equivalent Vulgar Fractions, then multiply their Numerators into each other, and divide that Product first by the Denominator of one, and then by the Denominator of the other.

Application.

7. Multiply $7.68\dot{4}$ by $.4\dot{5}$

$$\begin{array}{r} 6916 \\ 41 \\ \hline 6916 \\ 27664 \\ \hline 9)\ 283.556 \\ \hline 9)\ 31.5062 \\ \hline 3.60069 \text{ \&c.} \end{array}$$

$7.68\dot{4}$ reduced to its equivalent Vulgar Fraction is $\frac{6916}{900}$ and $.4\dot{5} = \frac{41}{90}$. I multiply the Numerators and find the Product 283556 I point off 3 Decimal Places, and then divide by 9 and by 9, the significant Figures of Denominators.

8. Multiply $2.\dot{3}$ by $5.\dot{6}$ *Answ.* $13.\dot{2}$.

9. Multiply $1.\dot{1}$ by $1.\dot{1}$ *Answ.* $\dot{1}.2345679\dot{0}$.

10. Multiply $3.\dot{1}\dot{4}5$ by $4.\dot{2}9\dot{7}$ *Answ.* $13.5\dot{1}6953\dot{3}$.

CHAP.

CHAP. X.

DIVISION OF CIRCULATING DECIMALS.

I. To divide a Circulate by a finite Decimal, &c.

DIvide as if they were both finite Decimals carrying on the Operation by bringing down the Figures of the Repetend (instead of Cyphers) so oft till either the Quote Circulate; or till a sufficient Number of Places result.

1. Divide 195.02 by .4.

4) 195.022, &c.

48.755, &c. = 48.75

2. Divide 46.5287 by 8 — *Answ.* 5.816091

3. —— 5.7648 by 68. — *Answ.* 8.47.

4. —— 6.559903 by 48.76. — *Answ.* 1345.

II. If the Divisor be a Circulate, make the Repetends of the Divisor and Dividend similar. Then instead of them using the Numerators of their equivalent Vulgar Fractions, and bringing them to one common Denominator, divide the Numerator of the Dividend by the Numerator of the Divisor as finite Decimals.

Explanation and Reason.

5. Divide 2.16595 by 4

.04)2. 16595
0 21659
4) 19.4936
4.8734

The mixed number 2.16595 having the Figure 5 a Repetend, is given similar to the Divisor. Then by subtracting the finite Part I reduce it to its equivalent Vulgar Fraction $\frac{194936}{90000}$. Then by making the decimal Places equal in Number to the Cyphers of the Denominator 90000, I reduce it to a mixt Fraction whose Denominator is 9, the same with that of the Numerator: So I divide $\frac{19.4936}{9}$ by $\frac{4}{9}$.

Note, The Decimal Places in the Divisor and Dividend will still be equal to the Cyphers in their Denominators.

6. Divide 54 by .17 — *Answer*, 303.75.

7. —— 411,3519 by 58.7645 — *Answ.* 7.

8. —— 9 by 45 —— 19.8.

9. —— 13.2 by 5.6. —— 2.3

10. —— 1.23456790 by 1.1. —— 1.1

11. —— 13,5169533 by 4.297 —— 3,145

BOOK

BOOK III.

MERCANTILE ARITHMETICK.

CHAP. I.

PRACTICE.

PRACTICE is a compendious Way of finding the Price of any Quantity of Goods having the Price of 1 given.

If any aliquot Part be ſubtracted from its Whole, I call the Remainder its Complement, as 5*s*. ſubtracted from 20*s*. of which it is an aliquot Part, the remainder is 15*s*. which I call the Complement of 5*s*. and the correſpondent Parts $\frac{3}{4}$ the Complement of $\frac{1}{4}$.

Caſe I. *Of Multiples of* 1l. 1s. *or* 2s.

I. When the Price is Pounds only, or a Multiple of 1*l*. multiply the Quantity by the Price, and the Product is the Anſwer in Pounds.

The Application and Reaſon are evident,

1. What come 110 *C*. of Hops to, at 4*l*. *per C*.?
Anſwer, 440*l*.

2. What come 227 Yards of Brocade to, at 3*l*. *per* Yard?
Anſwer, 681*l*.

3. What's the Amount of 56 Pieces of Chintz, at 5*l*. *per* Piece? *Anſwer*, 280*l*.

4. What's the Amount of 27 Ton of Tallow, at 26*l*. *per* Ton? *Anſwer*, 702*l*.

II. When

II.

When the Price is Shillings only.

1. If the Price of 1 be 2*s.* then the Price of any Quantity is discoverable at sight, *viz.* by accounting the double of the Units Figure Shillings; and the other Figures of the given Quantity Pounds: So 278 Yards at 2*s.* *per* Yard, will cost 27*l.* 16*s.*; for the double of 8 is 16, which write down apart as Shillings, then 27 the other Figures of the Quantity are to be esteemed Pounds: So the Answer is 27*l.* 16*s.*

	278
l.	27 : 16

2. If the Shillings be any even Number.

Multiply the Quantity by half the Number of the given Shillings, and double the Units of the Product for Shillings; the other Figures of the Product are Pounds.

Application.

Let it be required to find the Price of 736 Yards, at 4*s.* *per* Yard. I multiply 736 by 2, (the half of 4*s.*) saying, twice 6 is 12; the double of 2 (*viz.* the Units in the Product) is 4, to be set apart for Shillings, keeping 1 in mind for one Ten. Again, twice 3 is 6 and 1 I carry is 7; and so proceeding as in *Multiplication*, I find the Answer, 147*l.* 4*s.*

	736
	2
Answ. *l.*	147 4

Examples.

6. What cost 256 Gallons of Shrub, at 6*s.* *per* Gallon?
Answer, 76*l.* 16*s.*

7. What cost 984 lb of Green Tea, at 8*s.* *per* lb?
Answer, 393*l.* 12*s.*

8. What cost 120 *C.* of Beef, at 10*s.* *per C*?
Answ. 60*l.*

9. What

9. What must I give for 427 Reams of Paper, at 12*s.* *per* Ream? *Answer*, 256*l.* 4*s.*

10. Sold 78*C.* of Cheese, at 14*s.* *per Cwt.* what come they to? *Answer*, 54*l.* 12*s.*

11. At 16*s.* *per* Yard, what cost 526 Yards of Broad-Cloth? *Answer*, 420*l.* 16*s.*

12. What come 156*C.* of Rice to, at 18*s.* *per Cwt.*? *Answer*, 140*l.* 8*s.*

3. If the Shillings be odd;

Find the Amount of the even Number less by 1 than the given Price; and then take $\frac{1}{20}$ of the given Quantity and add it to the said Amount.

Examples.

13. At 3*s.* *per* Yard what cost 184 Yards of Linen?

		184	
		18	8 for 2*s.*
1*s.* is $\frac{1}{20}$		9	4
	l.	27	12

14. What cost 924 Barrels of Barley, at 7*s.* *per* Barrel? *Answer*, 323*l.* 8*s.*

15. At 9*s.* *per* Stone, what cost 347 Stone of Wool? *Answer*, 156*l.* 3*s.*

16. At 11*s.* *per* Stone, what cost 833 Stone? *Answer*, 458*l* 3*s.*

17. What come 129 *Cwt.* of Iron to, at 13*s.* *per Cwt.*? *Answer*, 83*l.* 17*s.*

2. Or otherwise, Multiply the Quantity by the said Shillings, and the Product is the Answer in Shillings, which reduce to Pounds.

18. What

18. What is the Price of 924 Barrels of Barley, at 7*s.*?
Answer, 323*l.* 8*s.*

19. At 9*s.* *per* Stone, what cost 347 Stone of Wool?
Answer, 156*l.* 3*s.* &c.

III.

When the Price is Pounds and Shillings;
Find the Price for the Pounds *per Case* I. and for the Shillings by Case II. and add the two Prices together.

20. What cost 178 *C.* of Sugar, at 2*l.* 4*s.* *per*?

```
            178
              2   2
          ---------    l.  s.
            356   0  for 2  0  per Case 1.
             35  12  for 0  4  per Case 2.
          ---------
Answ. l.    391  12
          ---------
```

What cost 234, at 1*l.* 8*s.*?

```
     234
      93  12
   ---------
l.   327  12
   ---------
```

At 5*l.* 7*s.* *per*, what cost 327?

```
     327                327 at 7
       5  7                7
   ---------          ---------
    1635                2281|9
     114  9           ---------
   ---------           114  9
l.  1749  9           ---------
   ---------
```

Otherwise thus:

If the Shillings be odd, bring the Pounds and Shillings into Shillings, and find the Price *per* Case 2 Part 2.

```
      327 at 5  7
      107      20
     -----    -----
      2289     107
      327
     -----
  2|0) 3498|9
  l.   1749 9
```

21. What

21. What coſt 275 ℔ of Cochineal, at 1*l.* 12*s. per* ℔?
Anſwer, 440*l.*

22. At 3*l.* 8*s. per Cwt.* what coſt 124 *Cwt.* of Hops?
Anſwer, 421*l.* 12*s.*

23. What coſt 237 *C.* of Sugar, at 2*l.* 13*s. per C.*?
Anſwer, 628*l.* 1*s.*

Caſe II. *Of Aliquot Parts.*

In Order to manage *Practice* by Aliquot Parts more readily and eaſily, it will be neceſſary for the learner to commit to Memory the following

PRACTICE TABLES.

1. *Aliquot Parts of* 1 *Pound.*				*Aliquot Parts of* 1 *Shilling.*			
s. d.	*l.*		*s d*				*d.*
10 0	is $\frac{1}{2}$	Complem.	10 0	6 Pence	$\frac{1}{2}$	Complement	6
6 8	— $\frac{1}{3}$	———	13 4	4 ——	$\frac{1}{3}$	———	8
5 0	— $\frac{1}{4}$	———	15 0	3 ——	$\frac{1}{4}$	———	9
4 0	— $\frac{1}{5}$	———	16 0	2 ——	$\frac{1}{6}$	———	10
3 4	— $\frac{1}{6}$	———	16 8	$1\frac{1}{2}$ ——	$\frac{1}{8}$	———	$10\frac{1}{2}$
2 6	— $\frac{1}{8}$	———	17 6	1 ——	$\frac{1}{12}$	———	11
2 0	— $\frac{1}{10}$	———	18 0				
1 8	— $\frac{1}{12}$	———	18 4	*Aliquot Parts of* 2 *Shillings.*			
1 0	— $\frac{1}{20}$	———	19 0				
							s. d
0 6	— $\frac{1}{40}$	———	19 6	8 Pence	$\frac{1}{3}$	Complement	1 4
0 8	— $\frac{1}{30}$	———	19 4	6 ——	$\frac{1}{4}$	———	1 6
0 4	— $\frac{1}{60}$	———	19 8	4 ——	$\frac{1}{6}$	———	1 8
0 3	— $\frac{1}{80}$	———	19 9	3 ——	$\frac{1}{8}$	———	1 9
0 2	— $\frac{1}{120}$	———	19 10	2 ——	$\frac{1}{12}$	———	1 10

If the Price be an Aliquot Part of 1*l.*

Rule.

Divide the Quantity by the Denominator of the Fraction expreſſing the Part (as in *Diviſion of Money*), and the Quotient is the Anſwer.

Application.

Application.

24. What cost 375 lb, at 10*s*. *per* lb?

10*s*. is $\frac{1}{2}$	375	
	l. 187	10

10*s*. is $\frac{1}{2}$*l*. So I divide 375 the Quantity, by 2 the Denominator of $\frac{1}{2}$, as already taught in *Division of Money*, and find the Quotient 187*l*. 10*s*.

Examples.

25. At 6*s*. 8*d*. *per* Yard, what is the Amount of 337 Yards of Holland? *Answer*, 112*l*. 6*s*. 8*d*.

26. What cost 1928 Hats, at 5*s*. *per*? *Answ*. 482*l*.

27. At 4*s*. *per* Pair, what cost 726 Pair of Shoes? *Answer*, 145*l*. 4*s*.

28. What come 936 lb of Coffee to, at 3*s*. 4*d*. *per* lb? *Answer*, 156*l*.

29. At 2*s*. 6*d*. *per* lb, what cost 224 lb? *Answ*. 28*l*.

30. What cost 1755 Pair of Stockings, at 2*s*. *per* Pair? *Answer*, 175*l*. 10*s*.

31. At 1*s*. 8*d*. *per* Yard, what cost 3127 Yards of Dowlass? *Answer*, 260*l*. 11*s*. 8*d*.

32. Bought 1584 lb of Loaf Sugar, at 1*s*. *per* lb, what comes it to? *Answer*, 79*l*. 4*s*.

II. If the Price be the Aliquot Part of a Shilling, divide the Quantity by the Denominator of the Part, the Quotient is Shillings which divide by 20 to bring it to Pounds.

At 6*d*. *per* lb, what cost 112 lb of Sugar?

6*d*. $\frac{1}{2}$	112
	2|0) 5|6
	l. 2 16

The Reason is manifest.

At

33. At 4*d.* *per* Quart, what must I give for 504 Quarts?
Answer, 8*l.* 8*s.*

34. At 3*d.* *per oz.* what come 156*oz.* to? *Answ.* 1*l.* 19*s.*

35. At 2*d.* *per* Yard, what cost 758 Yards of Tape?
Answer, 6*l.* 6*s.* 4*d.*

36. At $1\frac{1}{2}$*d.* *per* lb, what *per Cwt.*? *Answer*, 14*s.*

37. What will 976 lb come to, at 1*d.* *per* lb?
Answer, 4*l.* 1*s.* 4*d.*

If the Price be an even Part of 2 Shillings;
1. Find the Amount of the Quantity at 2 Shillings, which Amount divide by the Denominator of the Part, and the Quotient is the Answer.

38. At 8*d.* *per* lb, what cost 326 lb?

	l.	*s.*		
8*d.* $\frac{1}{3}$	32	12		at 2*s.* *per.*
	l. 10	17	4	*Answer.*

39. At 6*d.* *per* Yard, what cost 560 Yards? *Answ.* 14*l.*

40. At 4*d.* *per* lb, what cost 504 lb? *Answer*, 8*l.* 8*s.*

41. At 3*d.* *per* lb, what come 156 to? *Answer*, 1*l.* 19*s.*

Note, When the Pence are an even Part both of a Pound and Shilling, (*per* Table) as 6 $\frac{1}{40}$*l.* $\frac{1}{2}$*s.*; 4 $\frac{1}{60}$*l.* $\frac{1}{3}$*s.*; the Price may be very expeditiously and conveniently discovered as follows:

d.	*l.*	*s.*				
6 is	$\frac{1}{40}$	$\frac{1}{2}$	1751	5		at 6
			l. 43	17	6	

d.	*l.*	*s.*			
4 is	$\frac{1}{60}$	$\frac{1}{3}$	1751	5	at 4
			l. 29	5	

Explanation.

Explanation.

I divide the given Quantity by 40, which denominates the Part which 6*d.* is of a pound, and thereby get the Pounds, and by dividing the Remainder by ½ the Part which 6*d.* is of 1*s.* I find the Shillings and Pence, if any, *viz.* 4|0 dividing 1755 the Quotient is 43 and the Remainder 35; I ſay ½ 35*s.* is 17*s.* and 1 remains, which I multiply by 12 makes 12*d.* the ½ whereof is 6*d*: And ſo I find the Anſwer 43*l.* 17*s.* 6*d.*

After this manner let the Examples be wrought.

Caſe III. *Of the Complements.*

I. When the Price is the Complement of an Aliquot Part of 1*l.*

Rule.

Find the Amount at the Aliquot Part whereof it is the Complement (*per laſt*) and ſubtract the ſame from the Quantity taken as ſo many Pounds, the Remainder is the Anſwer.

Application.

42. Let it be required to find the Price of 713 lb, at 13*s.* 4*d.* *per* lb?

s.	*d.*		*l.*		
			713	at 13	4
13	4	Comple. ⅓—	237	13	4
		l.	475	6	8

43. At 15*s.* *per Cwt.* what coſt 336*C* of Logwood?
Anſwer, *l.*252

44. How much coſt 194 Yards of Broad Cloth, at 16*s.* 8*d.* *per* Yard. *Anſwer*, *l.* 161 13 4.

45. What coſt 479 Yards of Velvet, at 17*s.* 6*d.* *per* Yard?
Anſwer, *l.* 419 2 6.

46. At 18*s.* 4*d.* *per Cwt.* what coſt 95 *Cwt.* of Rice?
Anſwer, *l.* 87 1 8.

47. At

47. At 19*s.* *per Cwt.* what come 317 *Cwt.* of Butter to?
Answer, l. 301 3 0.

The Complement of the Aliquot Part of a Shilling.

48. At 9*d.* *per* Pound, what cost 1784 Pound of Tobacco?

Here 9*d.* is the Complement of $\frac{1}{4}$*s.* I take $\frac{1}{4}$ out of 1784 taken as Shillings, then the Remainder is 1338*s.* &c.

		1784
d.	*s.*	
9 is Comp.	$\frac{1}{4}$	446
		2|0)1331|8
Answer, l.		66 18

49. At 10*d.* *per* Yard, what cost 540 Yards of Flannel?
Answer, l. 22 10 0.

50. How much cost 7644lb, at 10$\frac{1}{2}$*d.* *per* lb?
Answer, l. 334 8 6.

51. What's the Price of 5649lb of Pepper, at 11*d.* *per* lb?
Answer, l. 258 18 3.

III. *Of 2 Shillings.*

First find the Amount of the Quantity at 2*s* *per*, and the said Amount divide by the Denominator of the Aliquot Part, the Quotient must be subtracted from the Amount at 2*s.* and the Remainder is the Answer.

52. What cost 524 Yards of Linen, at 1*s.* 4*d.* *per* Yard?

		l.	*s.*		*s.*
s. *d.*		52	8	Amount at	2 *per.*
1 4 is Comp.	$\frac{1}{3}$	17	9 4	at	0 8*d.*
	Answ.	34	18 8	at	1 4.

53. What cost 1648lb of Hops, at 1*s.* 6*d.* *per* lb?
Answer. l. 123 12.

54. At 1*s.* 9*d.* *per* Ell, what cost 729 Ells of Dowlas?
Answer, l. 63 15 9.

55. What is the Price of 1738 Gallons of Cyder, at 1*s.* 10*d.* *per* Gallon? *Answer, l.* 159 6 4.

Case

Case IV. *Of Aliquot Parts, into Complements.*

Any Aliquot Part (of a Pound or Shilling) may be divided into ſeveral Aliquot Parts thus. Take the greateſt Aliquot Part, leſs than the given Aliquant Part, out of the ſaid Aliquant Part, then if the Remainder be likewiſe an Aliquot Part, the thing propoſed is manifeſtly effected: So if 5*d.* be the Aliquant Part of a Shilling, given to be divided into Aliquot Parts, I know (from the Table) that 4*d.*—$\frac{1}{3}$*s.* is the greateſt Aliquot Part leſs than 5*d.* and 1*d.* remains, which is likewiſe an Aliquot Part, *viz.* $\frac{1}{12}$; So 7*d.* may be divided into 6—$\frac{1}{2}$*s.* and 1*d.*—$\frac{1}{12}$; 7$\frac{1}{2}$*d.* into 6—$\frac{1}{2}$*s.* and 1$\frac{1}{2}$*d.*—$\frac{1}{8}$*s.* &c. In like manner we may divide 7*s.* 6*d.* into 5*s.*—$\frac{1}{4}$*l.* and 2*s.* 6*d.*—$\frac{1}{8}$*l.*; 12*s.* 6*d.* into 10*s.*—$\frac{1}{2}$*l.* and 2*s.* 6*d.*—$\frac{1}{8}$*l.*; 11*s.* 8*d.* into 10*s.*—$\frac{1}{2}$*l.* and 1*s.* 8*d.*—$\frac{1}{12}$*l.* &c.

But if the Remainder be not an Aliquot Part, then take again the *greateſt Aliquot Part (leſs than it) out of the Remainder, and ſo on, and thus at laſt we ſhall divide the given Aliquant Part into ſeveral Aliquot Parts, whoſe Sum ſhall be equal to the ſaid Aliquant Part; Thus we may divide

$9\frac{3}{4}$	$8\frac{1}{2}$	$11\frac{3}{4}$	12 $7\frac{1}{2}$
6—$\frac{1}{2}$*s.*	6—$\frac{1}{2}$*s.*	6—$\frac{1}{2}$*s.*	10 0—$\frac{1}{2}$*l.*
3—$\frac{1}{4}$	2—$\frac{1}{6}$	4—$\frac{1}{3}$	2 6—$\frac{1}{8}$
0$\frac{3}{4}$—$\frac{1}{16}$	0$\frac{1}{2}$—$\frac{1}{24}$	1—$\frac{1}{12}$	1$\frac{1}{2}$—$\frac{1}{160}$
		0$\frac{3}{4}$—$\frac{1}{16}$	

Thus it is ſhewn how to divide any Aliquant Part into Aliquot Parts of the Whole. But as the leaſt Parts may ſometimes

* In ſome Caſes it may be more convenient to take a leſſer Aliquot Part rather than the greateſt (in the Remainder) as if 4*s.* 6*d.* were to be divided into Aliquot Parts of 1*l.*; the greateſt Aliquot Part leſs than 4*s.* 6*d.* is 3*s.* 4*d.* and it will by the Rule be divided into

s.	*d.*			*s.*	*d.*
3	4	$\frac{1}{6}$	but is better divided	2	6 $\frac{1}{8}$
1	0	$\frac{1}{20}$		2	0 $\frac{1}{10}$
0	2	$\frac{1}{120}$			

Note, Expertneſs in the moſt commodious Diviſion is attained by *Practice*.

ſometimes have Denominators greater than 12, (which ſhould be avoided that the Diviſion may be performed) we may obſerve that the leſſer Aliquot Parts of the Whole, are often likewiſe Aliquot Parts of ſome greater Aliquot Part before taken, and by conſidering them in this Light we ſhall generally avoid large Diviſors: Thus may the foregoing Aliquant Parts be divided and conſidered as followeth;

d.	*d.*	*d.*	*s.* *d.*
$9\frac{3}{4}$ into	$8\frac{1}{2}$ into	$11\frac{3}{4}$ into	12 $7\frac{1}{2}$ into
6 -- $\frac{1}{2}$ of 1*s.*	6 -- $\frac{1}{2}$ of 1*s.*	6 -- $\frac{1}{2}$ of 1*s.*	10 0 -- $\frac{1}{2}$ *l.*
3 -- $\frac{1}{2}$ of 6*d.*	2 -- $\frac{1}{3}$ of 6*d.*	4 -- $\frac{1}{3}$ of 1*s.*	2 0 -- $\frac{1}{10}$ *l.*
$0\frac{3}{4}$ - $\frac{1}{4}$ of 3*d.*	$0\frac{1}{2}$ - $\frac{1}{4}$ of 2*d.*	1 -- $\frac{1}{4}$ of 4*d.*	0 6 -- $\frac{1}{4}$ of 2*s.*
		$0\frac{3}{4}$ - $\frac{1}{8}$ of 6*d.*	0 $1\frac{1}{2}$ - $\frac{1}{4}$ of 6*d.*
$9\frac{3}{4}$	$8\frac{1}{2}$	$11\frac{3}{4}$	12 $7\frac{1}{2}$

I. When the Price is an Aliquant Part of a Pound.

Firſt divide the given Price into Aliquot Parts of a Pound; then divide the given Quantity by the Denominator of each Aliquot Part ſucceſſively; Thirdly, add all the Quotients into one Sum, and that Sum is the Anſwer required.

Application.

Let it be required to find the Price of 198 Yards of Broad-cloth, at 14*s.* 6*d.* *per* Yard?

s.	*d.*		*l.* 198	
10	0	is $\frac{1}{2}$	— 99	
2	6	is $\frac{1}{8}$	— 24	15
2	0	is $\frac{1}{10}$	— 19	16
			l. 143	11

Otherwiſe thus:

When a leſſer Part is an Aliquot Part of a greater taken before; divide the Amount or Quotient of the greater, by the Denominator of the leſs, and ſo will the ſame Quotient be found as by dividing the Quantity as *per* laſt.

Application.

Application.

Let the ſame Example be repeated.

				198	
	s.	*d.*			
	10	0 is	$\frac{1}{2}$	99	
of 10*s.*—2		6	$\frac{1}{4}$	24	15
of 10*s.*—2		0	$\frac{1}{5}$	19	16
			l.	143	11

Examples.

1. *Of a Pound.*

56. How much is the Amount of 4563 Cobbs, at 4*s.* 9*d.* *per* Piece? *Anſwer*, *l.* 1083 14 3.

57. What muſt I give for 127 Yards of Cloth, at 9*s.* 8$\frac{1}{2}$*d.*? *Anſwer*, *l.* 61 12 11$\frac{1}{2}$.

58. At 10*s.* 6*d.* *per* lb, what coſt 387 lb of Tea? *Anſwer*, *l.* 203 3 6.

59. At 9*s.* 10*d.* *per* Piece, what amount 139 to? *Anſwer*, *l.* 68 6 10.

60. At 12*s.* 3*d.* *Cwt.* what come 120 *Cwt.* to? *Anſwer*, *l.* 73 10.

61. At 15*s.* 6*d.* *per Cwt.* what will 721 *Cwt.* come to? *Anſwer*, *l.* 558 15 6.

62. At 19*s.* 11$\frac{3}{4}$*d.* *per Cwt.* what coſt 95 *C.*? *Anſwer*, *l.* 94 18 0$\frac{1}{4}$.

63. At 2*s.* 8$\frac{1}{2}$*d.* *per* Piece, what come 1784 to? *Anſwer*, *l.* 241 11 8.

2. *Of a Shilling.*

Divide the Aliquant Part into ſeveral Aliquot Parts and proceed as before; only the Sum will be Shillings, &c. which muſt therefore be divided by 20 to give the Anſwer in Pounds.

	8729 at 5*d.*	
4*d.* $\frac{1}{3}$*s.*—	2909	8
1*d.* $\frac{1}{4}$ of 4*d.*—	727	5
2|0)	3631|7	1
Answer, *l.*	181 17	1

65. What cost 540 Yards of Canvass at 7*d.* *per* Yard? *Answer*, *l.* 15 15.

66. What cost 229lb of Sugar, at 7$\frac{1}{2}$*d.*? *Ans.* *l.* 7 3 1$\frac{1}{2}$.

67. At 9$\frac{3}{4}$*d.* how much cost 329lb? *Ans.* *l.* 13 7 3$\frac{1}{2}$.

Case V. When the Price is 1*l.* 1*s.* or 2*s.* and an Aliquot or Aliquant Part of the same.

Find the Amount of the Parts, and add the Quotient or Quotients together with the given Quantity into one Sum.

Examples.

Parts		*s.* *d.*	1 and a Part.		*l.* *s.* *d.*
	337 Yards at	6 8	1*l.* ——	337 at	1 6 8
6*s.* 8*d.* $\frac{1}{3}$—	112 6 8	*Answ.*	6*s.* 8*d.* is $\frac{1}{3}$—	112 6 8	
				l. 449 6 8	
	198 at 14 6		1*l.* ——	198 at	1 14 6
10*s.* is $\frac{1}{2}$—	99		10*s.* is $\frac{1}{2}$—	99	
2*s.* 6*d.* $\frac{1}{4}$—	24 15		2*s* 6*d.* $\frac{1}{8}$—	24 15	
2*s.* is $\frac{1}{10}$—	19 16		2*s.* is $\frac{1}{10}$—	19 16	
	l. 143 11	*Answ.*		*l.* 341 11	
	378 at 8*d.*			378 at 2*s.* 8*d.*	
	37 16 at 2*s.*			37 16 at 2 0	
8*d.* is $\frac{1}{3}$--2*s.*	12 12	*Answ.*	8*d.* is $\frac{1}{3}$—	12 12 at 0 8	
				l. 50 8 at 2 8	
	672 at 7*d.*		1*s.* ——	672 at	1*s* 7*d.*
6*d.* $\frac{1}{2}$—	336		6*d.* is $\frac{1}{2}$—	336	
1*d.* $\frac{1}{6}$—	56		1*d.* is $\frac{1}{6}$—	56	
2|0)	391|2		2|0)	1061|4	
	l. 19 12			*l.* 53 4	

1 Of

1. *Of a Pound.*

68. What is the Amount of 127 *C.* of Butter at 23*s.* 4*d.*?
Answer, *l.* 148 3 4.

69. How many Pounds in 125 Guineas?
Answer, } *l.* 131 5 0 *Eng.* Currency,
142 3 9 *Irish.*

70. At *l.* 1 7 6 *per C. wt.* what cost 327 *C.* of Merchandise?
Answer, *l.* 449 12 6.

71. At *l.* 1 13 8½ *per C. wt.* what cost 315 *C.* of Madder?
Answer, *l.* 530 18 1½.

72. What is the Amount of 180 Moydores?
Answer, } *l.* 243 0 *English.*
263 5 *Irish.*

73. At *l.* 1 17 6 *per C. wt.* what cost 536 *C. wt.* of Sugar?
Answer, 1005*l.*

2. *Of 2 Shillings.*

If the Price be 2*s.* and an Aliquot or Aliquant Part thereof; first the Price for 2*s.* and then take the proper Parts out of the said Price and add thereto.

74. What cost 378 Yards of Linen at 2*s.* 2*d.* per Yard?
Answer, *l.* 40 19 0

75. At 2*s.* 4*d. per* Yard, what for 384 Yards?
Answer, *l.* 44 16 0.

76. At 2*s.* 5*d.* what cost 974? *Answ.* *l.* 117 13 10.

77. How much cost 3782 lb of Chocolate, at 2*s.* 8½*d. per* lb?
Answer, *l.* 512 2 11.

78. At 2*s*: 9½*d. per*, what cost 1245 lb?
Answer, *l.* 173 15 7½.

3. *Of a Shilling.*

79. At 1*s.* 1*d.* what 1275?

1*d.* is $\frac{1}{12}$	106	3	
2|0)	138|1	3	
Answer, *l.*	69	1	3

80. At 1*s.* 5$\frac{1}{2}$*d.* what 3284?

	3284	
4 is $\frac{1}{3}$	1094	8
1 is $\frac{1}{4}$	273	8
$\frac{1}{2}$ is $\frac{1}{2}$	136	10
2|0)	478|9	2
Answ. *l.* 239	9	2

81. At 1*s.* 3*d.* *per* lb. what cost 1785 lb. of Pepper?
Answer, *l.* 111 11 3.

82. At 1*s.* 4*d.* *per* Ell, what cost 852 Ells?
Answer, *l.* 56 16 0.

83. What come 2782 lb. to at 1*s.* 2$\frac{1}{2}$*d.*?
Answer, *l.* 168 1 7.

84. At 1*s.* 8$\frac{3}{4}$*d.* *per* what cost 327? *Answ.* *l.* 28 5 5$\frac{1}{4}$

85. At 1*s.* 10$\frac{1}{2}$*d.* what cost 439? *Answ.* *l.* 41 3 1$\frac{1}{2}$.

86. At 1*s.* 11$\frac{3}{4}$*d.* how much come 3864 to?
Answer, *l.* 382 7 6.

Case VI.

When the Price is any Number of Pounds or Shillings, and an Aliquot or Aliquant Part of the same.

1. *An Aliquot Part.*

87. What cost 317 *C.* at *l.* 4 3 4. *per* C. wt.

	4			
4	1268			*per Case* 1.
3*s.* 4*d.* $\frac{1}{6}$	52	16	8	*per* 4.
l.	1320	16	8	

[88] 3785 at 3*s*. 6*d*.

	3	
	11355	
6*d*. is ½	1892	6
2|0)	1324|7	6
	l.662 7	6

89. What cost 324lb. at 6*s*. 4*d*. *per* lb?
Answer, *l*. 102 12 0.

90. At *l*. 2 6 8. *per C. wt.* what cost 175 *C*?
Answer, *l*.408 6 8.

91. At 17*s*. 3*d*. *per C.* what cost 78 *C. wt.* of Cheese?
Answer, *l*. 67 5 6.

92. At 19*s*. 6*d*. *per* Piece, what amount 1784 to?
Answer, *l*. 1739 8 0.

93. At 4*s*. 8*d*. *per* Yard, what cost 3752 Yards of Linen?

	3752		
	375	4	for 2*s*.
		2	
	750	8	for 4*s* *per Case* I.
8*d*. of 2*s*. is ⅓	125	1 4	
Answer, *l*.	875	9 4	

94. At 6*s*. 4*d*. *per* what cost 324? *Answ. l*. 102 12 0.
95. At 18*s*. 3*d*. What amount 59 to? *Answ. l*. 53 16 9.

2. *The Complement of an Aliquot Part.*

Rule.

Multiply the Quantity by 1 more than the given Number of Pounds or Shillings; then divide the Quantity by the Denominator of the Fraction expressing the Aliquot Part whose Complement is given, and subtract the Quotient from the Product.

Example.

		C.		*l.*	*s.*	*d.*		
	What cost	278 at		1	16	8 *per* C. wt.		
		2						
				l.	*s.*	*d.*		
s. *d.*		556 —— for		2	0	0		
16 8 is Com. $\frac{1}{6}$ —	46	6	8 —	0	3	4 Subt.		
Amount to *l.*	509	13	4 at	1	16	8 *per* C. wt.		

The Reason like that of *Case* III.

96. At 4*s.* 10$\frac{1}{2}$*d.* *per* lb. what cost 3185 lb of Coffee?
Answer, *l.* 776 6 10$\frac{1}{2}$.

97. At *l.* 2 17 6 *per* C. wt. what cost 424 *C.* of Raisins?
Answer, 1219*l.*

98. What is the Price of 1847 Yards of Cloth, at 5*s.* 8*d.* *per* Yard? *Answer*, *l.* 523 6 4

99. At *l.* 3 15 0 *per* C. wt. what cost 172 *C.* of Hops?
Answer, 645*l.*

100. How much is the Amount of 4563 Cobs at 4*s.* 9*d.* *per*? *Answer*, *l.* 1083 14 3.

101. At 9*s.* 10*d.* *per* Piece, what amount 139 to?
Answer, *l.* 68 6 10.

3 *Any Aliquot Part.*

102. What cost 54 Ton of Iron, at *l.* 12 10 6 *per* Ton?

1. Thus	2. Or thus,	3. Or thus,
Ton *l.* *s.* *d.*	54 at 12 10 6	54 at 12 10 6
54 at 12 10 6	250 20	6
12	250 6	
l. 648 *per Case* 1	2700 } for 250*s.*	75 3 0
10*s.* is $\frac{1}{2}$ 27 } *per* $\frac{1}{2}$	108 } for — 6*d.*	9
6*d.* is $\frac{1}{20}$ 1 7 } *Ca.* 4	27	676 7 0
l. 676 7 *Answer.*	13527	
	l. 676 7	

Examples.

Examples.

103. What cost 540 Yards of Broad-Cloth, at 17*s.* 9*d.*
Answer, *l.* 479 5.

104. What cost 313 *C.* of Cheese at 14*s.* 6*d.*
Answer. *l.* 226 18 6.

105. At 11*s.* 11*d* *per* what cost 731 Ells?
Answer, *l.* 435 11 1.

106. At *l.* 3 17 5 *per* Cwt. what come 517 *C.* of Hops to?
Answer, *l.* 2001 4 5.

107. What cost 108 *C.* at *l.* 5 13 8 *per*?
Answer, *l.* 613 16.

108. At *l.* 4 9 10¾. *per C.* what cost 17 C.wt.?
Answer, *l.* 76 8 2¾.

109. What is the Price of 129 Ton of Butter, at *l.* 19 19 4½?
Answer, *l.* 2575 19 4½.

110. To how much come 48756 Skains of Worsted at 1*l.* 4*s.* 6*d.* *per* 100? *Answer*, *l.* 597 5 2$\frac{16}{25}$.

CHAP. I. PART II.

OF THE QUANTITY.

TABLES.

Aliquot Parts of 1 C.wt.						*Parts of* ½ C.wt.		*Parts of* ¼ C wt.
qrs.	lb.	*C.wt.*		*qrs.*	lb.	*qr.*	lb.	lb.
2	0	is ½	Complem.	2	0	1	0 is ½	14 is ½
1	0	— ¼	———	3	0	0	14 — ¼	7 — ¼
0	16	— $\frac{1}{7}$	———	3	12	0	8 — $\frac{1}{7}$	4 — $\frac{1}{7}$
0	14	— ⅛	———	3	14	0	7 — ⅛	3½ — ⅛
0	8	— $\frac{1}{14}$	———	3	20			
0	7	— $\frac{1}{16}$	———	3	21			

Case I.

When the Quantity is a Fraction; or of a lesser Denomination, or Denominations, and the Price of 1 of a higher is given.

Rule.

Divide the given Price of 1, by the Denominator of the Fraction, or Aliquot Part, when the less is,

1. *An Aliquot Part.*

1. What will $\frac{1}{4}$ of 1 C. come to, at the Rate of 29*s*. 6*d*. *per* C.?

		s.	*d.*	
		29	6	
1 *qr.* is $\frac{1}{4}$—	*l.* 0	7	$4\frac{1}{2}$	*Answer.*

Reason.

The Reason is obvious from considering the Solution by the *Rule of three*, viz. 1 C.——29*s*. 6*d*.——$\frac{1}{4}$. For I have multiplied 29*s*. 6*d*. by $\frac{1}{4}$, and 1 divides not.

2. If a Yard of Cloth cost 8*s*. 6*d*. what cost $\frac{1}{2}$ Yard? *Answer*, 4*s*. 3*d*.

3. What cost 16 lb. of any Thing, at *l* 3 13 6 *per* C.? *Answer*, 10*s* 6*d*.

4. At 5*s* 6*d*. *per* oz. what cost a pair of Silver Buttons weighing 5 Penny-weight? *Answer*. 1*s*. $4\frac{1}{2}$*d*.

5. What will 14 lb of Sugar come to, at the Rate of 45*s*. *per* C. wt? *Answer*, 5*s*. $7\frac{1}{2}$*d*

6. What will 7lb. be worth, if 1 C. wt cost 36*s*. 4*d*.? *Answer*, 2*s*. $3\frac{1}{4}$*d*.

2. *The Complement.*

Rule.

Subtract the Quotient (found by dividing the Price by the Denominator of the Part whereof it is the Complement) from the Price, and the Remainder is the Answer.

7. What

7. What will $\frac{3}{4}$ of a C. wt. come to at 29*s.* 6*d.* *per* C. wt.?

	29	6
$\frac{3}{4}$ Comp. is $\frac{1}{4}$—	7	$4\frac{1}{2}$
Answer, *s.*	22	$1\frac{1}{2}$ or *l.* 1 2 $1\frac{1}{2}$.

8. At 15*s.* 6*d.* *per* Yard what cost $\frac{7}{8}$ of a Yard?
Answer, 13*s.* $6\frac{3}{4}$*d.*

9. What cost 3*qrs.* 14 lb of Sugar at 2*l.* 5*s.* 6*d.* *per* C. wt.?
Answer, 1*l.* 19*s.* $9\frac{3}{4}$*d.*

10. What cost 3*qrs.* 20 lb, at 3*l.* 12*s.* 4*d.* *per* C. wt.?
Answer, 3*l.* 7*s.* 2*d.*

11. At 5*s.* 6*d.* *per* Ounce, what cost a pair of Buckles weighing 15 Penny-weights? *Answ.* 4*s.* $1\frac{1}{2}$*d.*

12. At 17*s.* 6*d.* *per* Yard, what cost 3*qrs.* 2 *Nails*?
Answer, 15*s.* $3\frac{3}{4}$*d.*

3. *Any Aliquot Part.*

Rule.

Divide the Aliquant Part into several Aliquot Parts, and divide the given Price by the Denominators of these several Aliquot Parts successively: the Sum of all the Quotients will be the Answer.

Examples.

13. If 1 C. wt. of Madder be worth 2*l.* 10*s.* what is 3*qrs.* 16lb. worth?

qrs.	lb.		*l.*	*s.*			*qrs.*	lb.
3	16 at		2	10				
2	0 is $\frac{1}{2}$—		1	5		—Amount of	2	0
1	0 is $\frac{1}{4}$—		0	12	6	—	1	0
0	16 is $\frac{1}{7}$—		0	7	$1\frac{5}{7}$	—	0	16
	Answer,	*l.*	2	4	$7\frac{5}{7}$	—	3	16

14. What will 2*qrs.* 14lb. come to if 1 C. wt. coſt 50*s.*?
Anſwer, l. 1 11 3.

15. If 1 C. wt. coſt 46*s.* 6*d.* what coſt 1*qr.* 14lb.?
Anſwer, 17*s.* $5\frac{1}{4}$*d.*

16. At *l.* 17 10 8. *per* Ton, what will 3*C.* 3*qrs.* coſt?
Anſwer, l. 3 5 9.

17. How much will 12 Ounces of Silk coſt, if 1 lb coſt 3*l.* 10*s.*? *Anſwer, l.* 2 12 6.

18. What will 3*qrs.* 21*lb.* of Tallow come to, at the Rate of 27*s.* 8*d. per* C. wt.? *Anſwer, l.* 1 5 $11\frac{1}{4}$.

19. What $7\frac{7}{8}$ *oz.* of Spice come to at 12*s.* 8*d. per lb.*?
Anſwer, 6*s.* $2\frac{13}{16}$.

20. What coſt 3*qrs.* 2 *Nails* of Velvet at the Rate of 17*s.* 6*d. per* Yard? *Anſwer,* 15*s.* $3\frac{3}{4}$*d.*

21. How much will 21 lb. of Sugar coſt, if 1 C. wt. coſt 54*s.* 4*d.*? *Anſwer,* 10*s.* $2\frac{1}{4}$*d.*

22. At *l.* 27 10 6. *per* C. wt. what coſt $14\frac{3}{4}$lb.?
Anſwer, l. 3 12 $5\frac{221}{224}$.

Caſe II.

If of divers Denominations the Price of 1 of the Lower is given.

Reduce them to the ſaid lower Denomination of which the Price is given, and find the Amount thereof by the former Rules.

	C.	*qrs.*	*lb.*
23. What coſt	4	3	12 of Pepper, at 1*s.* 3*d. per lb*?

4
4
484
12

544 Pounds at 1*s.* 3*d.*
3*d.* is $\frac{1}{4}$ 136

2|0) 68|0

Anſwer, l. 34

24. At

24. At $9\frac{3}{4}$ *per* lb. what coſt a Hogſhead of Tobacco weighing 12 *C.* 1*qr.* 25 *b.*? *Anſwer, l.* 56 15 $0\frac{1}{4}$.

25. What coſt 12*lb.* 10*oz.* of Silver at 5*s. per* Ounce? *Anſwer, l.* 38 10 0.

26. What will 224 *lb.* 6*oz.* of Spice come to, at the Rate of 3*s. per* Ounce? *Anſwer, l.* 538 10 0.

27. 12 *Hhds.* 36*Gal.* of Brandy, at 4*s. per* Gallon? *Anſwer, l.* 158 8 0.

28. If 1*lb.* of any Thing coſt 1*s.* 9*d.* what will 7 *C.* 2*qrs.* 26 *lb.* coſt? *Anſwer, l.* 75 15 6.

Caſe III.

When the Price of 1 of the higheſt is given.

For the Number of the higheſt find the Amount by the Rules of Part I. and for the lower as in Caſe I. of this, and add the Amounts together.

Examples.

29. What will 332 *C.* 2*qrs.* 22*lb.* come to, at the Rate of 18*s.* 6*d. per* C. wt.

	C.	*qrs.*	*lb.*			*s.*	*d.*			
	332	2	22	at		18	6			
		s.	*qrs.*							
	33 4	at 2	2	is $\frac{1}{2}$		9	3			
	9		14 *lb.*	$\frac{1}{4}$		2	$3\frac{3}{4}$		42	
			7	is $\frac{1}{2}$		1	$1\frac{7}{8}$		49	
	298	16	1	is $\frac{1}{7}$		0	$1\frac{55}{56}$		55	
6*d.* is $\frac{1}{4}$	8	6							146	
	0	12	$10\frac{17}{56}$			12	$10\frac{17}{56}$		56)	146 (2
										112
	307	14	$10\frac{17}{56}$							$\frac{34}{112} \mid \frac{17}{56}$

30. At 16*s.* 4*d. per* C. wt. what coſt 14 C. wt. 3*qrs.*? *Anſwer, l.* 12 0 11.

31. What will 193 *C.* 3*qrs.* coſt, at the Rate of 17*s.* $9\frac{1}{2}$*d.*? *Anſwer, l.* 172 7 $1\frac{1}{8}$.

32. At 16*s.* $5\frac{1}{4}$*d. per* C. wt. what coſt 203 *C.* 3*qrs.*? *Anſwer, l.* 167 9 $1\frac{1}{16}$.

33. If a Dozen of Candles coſt 3*s.* 3*d.* what will a Box of $5\frac{1}{2}$ Dozen come to? *Anſwer,* 17*s.* $10\frac{1}{2}$*d.*

34. What will 2061 *C.* 2*qrs.* 7*lb.* coſt at 16*s.* 6*d.* *per* C.wt.? *Anſwer, l.* 1700 15 $9\frac{3}{8}$

35. At 9*s.* 4*d.* *per* C. wt. what will 106 *C.* 3*qrs.* 14*lb.* come to? *Anſwer, l.* 49 17 6.

36. How much will 26*C.* 2*qrs.* 7*lb.* coſt, if 1C. coſt 15*s.* 9*d?* *Anſwer, l.* 20 18 $4\frac{5}{16}$.

37. If 1 *C.* coſt 21*s.* 6*d.* how much will 306*C.* 3*qrs.* 21*lb.* come to? *Anſwer, l.* 329 19 $1\frac{7}{8}$

38. What will 951 *C.* 2*qrs.* 27*lb.* coſt at 11*s.* 3*d.* *per* C.? *Anſwer, l.* 535 7 $1\frac{5}{112}$.

39. What will 506 *C.* 1*qr.* 11*lb.* come to at 13*s.* 7*d.* *per* C.? *Anſwer, l.* 343 17 $10\frac{85}{112}$.

40. What will 499*C.* 3*qrs.* 25*lb.* coſt, at 25*s.* 11*d.* *per* C.? *Anſwer, l.* 647 17 $7\frac{75}{112}$.

41. At 19*s.* 9*d.* *per* C. how much will 109*C.* 0*qrs.* 15*lb.* come to? *Anſwer, l.* 107 15 $4\frac{83}{112}$.

42. If 1*C.* coſt 15*s.* 2*d.* what will 753*C.* 1*qr.* 25*lb.* come to? *Anſwer, l.* 571 7 $8\frac{1}{8}$.

43. If 1lb. of Silk coſt *l.* 3 6 5, what will 80*lb.* 10*oz.* coſt? *Anſwer, l.* 267 14 $10\frac{1}{8}$.

44. How much will 1095*C.* 0*qrs.* 5*lb.* come to at the Rate of 17*s.* 6*d.* *per* C.? *Anſwer, l.* 958 3 $3\frac{3}{8}$.

45. What will 231*C.* 0*qrs.* 1*lb.* come to, if 1*C.* coſt 18*s.*? *Anſwer, l.* 207 18 $1\frac{13}{14}$.

46. If 1*lb.* of Silver coſt *l.* 3 4, what will 100*lb.* 11*oz.* come to? *Anſwer, l.* 322 18 8.

47. How much will 20 *Ton* 19*C.* 3*qrs* 14*lb.* come to, if 1 *Ton* coſt *l.* 19 19 6? *Anſwer, l.* 419 7 $0\frac{3}{80}$.

48. At *l.* 25 10 9 the *Ton*, what will 10 *Ton* 17*C.* 3*qrs.* come to? *Anſwer. l.* 278 0 $9\frac{39}{80}$.

49 At 6*s.* 9*d* the Yard what will 7*Yds.* $3\frac{1}{2}$*qrs.* come to? *Anſwer, l.* 2 13 $1\frac{7}{8}$.

50 If 1 *Ton* coſt *l.* 21 15 6 what coſt 25 *Ton* 15 *C.* 3*qrs.* $14\frac{1}{2}$*lb.*? *Anſwer, l.* 561 13 $3\frac{681}{2240}$.

51. What will 15*Yds* $1\frac{1}{2}$*qrs.* of Cloth coſt, if a Piece containing 42 Yards coſt *l.* 38 17 $6\frac{1}{2}$? *Anſwer, l.* 14 4 $7\frac{141}{224}$.

If

52. If 1 *C.* cost 19*s.* 11¾*d.* what will 11*C.* 3*qrs.* 27½*lb.* come to? *Answer*, *l.* 11 19 7$\frac{119}{128}$.

53. At *l.* 19 19 11¾*d.* the Ton, what will 19 *Ton* 19 *C.* 3*qrs.* 27½*lb.* come to? *Answer*, *l.* 399 19 5$\frac{16641}{17920}$.

PRACTICE *performed by* DECIMALS.

I. Since 2*s.* is $\frac{1}{10}$ Part of 1*l.* the Decimal of 2*s.* is 1; wherefore any Quantity being given at 2*s.* per, the Price is found in Pounds and Decimal Parts of a Pound, by separating the Units Figure of the given Quantity from the rest for a Decimal, the Value of which Decimal in Shillings is known by inspection.

Examples.

Let it be required to find the Value of 278 Yards, at 2*s.* *per* Yard. By pointing off the lowest Figure 8 for a Decimal, I find the amount *l.* 27.8, which is known to be equal to 27*l.* 16.

l.
27.8

II. Consequently if the Price be a Multiple of 2*s.* (*viz.* any even Number of Shillings) the amount of 2*s.* being first found in Pounds and Decimal Parts as above, and that Amount multiplied by the Number which expresseth how often 2*s.* is contained in the given Price, the Product will be the Amount required in Pounds and Decimal Parts of 1*l.* &c.

What cost 256 Gallons of Shrub. at 6*s.* *per* Gallon?

```
          l.          s.
        25.6 Amount at 2 per Gallon.
           3
        ----      l.   s.
Answer, l. 76.8 or 76  16
```

Let the Examples of Chap. I. be done by this Rule.

Likewise if the Price be Pounds and even Shillings.

```
      l   s.
475 at 1  12          Or 475        47.5
----                     285           6
47.5                    -----        -----
  16×2=32s.             l. 760       285 0
----
2850
475
----
l.760.0
-------
```

III. If the price be an Aliquot Part of 2 Shillings, find the Amount at 2*s.* and divide it by the Denominator of the Part.

At 8*d.* *per* lb what cost 326lb?

$$\begin{array}{llll} & \underline{32.6} & & \\ 8d.\text{ is } \frac{1}{3} - & 32.6 & & \\ & & l. \quad s. & d. \\ & l.\ 10\ 866 = 10 & 17 & 4 \end{array}$$

Let the Examples of Chap. II § 3 be done by this:

IV. If the Price be an Aliquant Part divide it into Aliquot Parts.

$$\begin{array}{ll} & 8729 \text{ at } 5d. \\ & \overline{872.9} \\ 4d.\text{ is } \frac{1}{6} - & 145.483 \\ 1d.\text{ is } \frac{1}{4} - & \underline{36.37075} \quad l.\ \ s.\ \ d. \\ & 181.85375 \text{ or } 181\ \ 17\ \ 1 \end{array}$$

$$\begin{array}{ll} & 524 \text{ at } 1s.\ 4d. \\ & \overline{52.4} \\ 8d.\text{ is Co. } \frac{1}{3} - & \underline{17.466} \quad l.\ \ s.\ \ d. \\ & 34.933 = 34\ \ 18\ \ 8 \end{array}$$

V. If the Price be Pounds and Shillings, or Pounds, Shillings and Pence: Reduce the lesser Denominations to the Decimal of a Pound, and multiply the Quantity thereby.

$$\begin{array}{rr} & l.\ \ s.\ \ d.\ \quad l. \\ 54 \text{ Ton, at} & 12\ \ 10\ \ 6 = 12.525\,? \\ & \underline{54} \\ & 50100 \\ & \underline{62625} \\ & 676.350 \\ & l.\ 676.\ \ 7 \end{array}$$

VI. if the Quantity likewise be of divers Denominations reduce the lesser Denominations to a Decimal of that whereof the Price is given.

80 lb 10 oz. of Silk at 3*l.* 6*s.* 5*d.* ?

lb oz. *l.* *s.* *d.*
80 10=80.625 3.32083=3 6 5
80233

241875
24188
1612
64

267.739

l. 267 14 $9\frac{1}{2}$

C. *qrs.* *s.* *d.*
14 3 at 16 4=.816
81

14.75 =735
735

7375 900
4425
10325

9) 108.4125

l. *s.* *d.*
$12.0458\dot{3}$=12 0 11

After the same Manner may the Examples of Case III. *p.* 185 be done.

Otherwise,
Take Parts for the lower Denominations, as,
80 10 3.32083
80

265.66640
$8\frac{1}{2}$ 1.660415
$2\frac{1}{4}$ .415103

267.741918

l. 267 14 10
14.75 at 16.4
:8

11.800
$4\frac{1}{12}$ .2458

$12.0458\dot{3}$

l. 12 0 11

PRAC-

PRACTICE

APPLIED IN CASTING UP COINS.

Paid *J. D.* in full for *T. S.* his Bill on me. 100*l.* *viz.*

		s.	d.	l.	s.	d.
22	at	18	3	20	1	6
12	at	18	1	10	17	0
27	at	29	3	39	9	9
26	at	22	9	29	11	6
Change				0	0	3
				l. 100	00	0

THE WORK.

s. d.	s. d.	l. s. d.	
22 at 18 3	12 at 18 1	27 at 1 9 3	Decimally
	12	29 for 1 9	27
2 4 at 2 *per*			·4×2=8
9	*l.* 10 17	243	
		54	10.8 for 8*s.*
d. 19 16	*l.* *s.* *d.*	$3\frac{1}{4}$ 6 9	1*s.* $\frac{1}{2}$ 1 35—1*s.*
$3\frac{1}{4}$ 0 5 6	26 at 1 2 9		3*d.* $\frac{1}{4}$ ·3375--3*d.*
	$2\frac{1}{10}$ 2 12	2|0)78|9 9	27. *l* 1
l. 20 1 6	$6\frac{1}{4}$*d.* 0 13		
	$3\frac{1}{2}$*d.* 0 6 6	*l.* 39 9 9	39·4875—1-9-3
	l. 29 11 6		*l.* 39 9 9

2. Received of *Abraham Adamson* for *Peter Drawer*'s Bill, 150*l.* *viz.*

		l.	s.	d.	l.	s.	d.
87	at	1	2	9			
$127\frac{1}{2}$	at	0	5	5			
17	at	0	18	3			
1	at	0	19	6			
Change					0	0	$4\frac{1}{2}$
					l. 150		

3. Paid *Samuel Thompson* 343*l.* for 343 Barrels of Beef, *viz.*

	s.	d.			l.	s.	d.
105 at	22	9	——	——			
100 at	18	3	——	——			
101 at	4	9	——	——			
400 at	5	5	——	——			
					343	0	2
			Change returned				2
					l. 343	0	0

4. Received from *J. D.* in Part Payment for Tobacco, *viz.*

	s.	d.		l.	s.	d.
127 at	5	5	——			
478 at	3	4	——			
1016½ at	1	1	——			
				l. 169	2	5½

5. Received of *R. F.* 259*l.* 7*s.* 9*d.* in Part of 1500 Stone of Wool sold him, *viz.*

	s.	d.		l.	s.	d.
300 at	5	5	——			
100 at	6	0	——			
150½ at	18	3	——			
199½ at	1	1	——			
				259	7	9

6. Paid *P. P.* on Account of 1000 Barrels of Wheat

	l.	s.	d.		l.	s.	d
981½ at	0	5	5	——			
314½ at	0	4	9	——			
72½ at	1	9	3	——			
94 at	1	9	1	——			
27½ at	0	18	3	——			
30 at	0	17	11	——			
13½ at	0	1	1	——			
					l. 635	18	9½

7. Received

7. Received of *B. G.* by Order and for Account of *S. S.* *viz.*

		s.	d.		l.	s.	d.
1036½	at	1	1	——			
931	at	3	4	——			
97	at	28	11	——			
104	at	28	9	——			
58	at	18	3	——			
275	at	18	1	——			
431½	at	22	9	——			
57½	at	29	3	——			
					l. 1377	11	0½

BILLS OF PARCELS.

Dublin, Sep. 18, 1796.

1. *James Bateman.*

Bought of *Edward Empson*,

		s.	d.		l.	s.	d.
27¼lb of *Smyrna* Coffee,	—at	5	8	*per lb.*			
23lb of Mocha ditto,	—at	5	4	——			
26½lb of Imperial Tea,	—at	25	0	——			
10¾lb of best Bohea,	—at	14	6	——			
13lb of Royal Green Tea	—at	18	8	——			
21lb of Sugar double refined	- at	1	0½	——			
					l. 70	13	4

10th *Nov.* 1796.

2. *Francis Pindust*,

Bought of *Isaac Hosier*,

	s.	d.		l.	s.	d.
15 Pair of Womens Worsted, mixt at	5	7	*per* P.			
23 Pair of Mens Silk ——	17	4	——			
22 Pair of Mens Yarn, ——	3	2	——			
18 Pair of *Norwich* Hose ——	4	9	——			
38 Pair of Thread, ——	3	4	——			
13 Pair of Womens Gloves, Silk, at	4	8	——			
				l. 41	4	11

Dublin, Feb. 8. 1796.

3. *George White,*

Bought of *John Brown* and Comp.

		s.	d.	l.	s.	d.
$10\frac{1}{2}$ Yards of *Yorkshire* Cloth,	at	6	6 *per Yd.*			
7 Yards of fine *Spanish* Black	at	16	3 ——			
$6\frac{3}{4}$ Yards of fine grey Cloth,	at	15	9 ——			
$16\frac{3}{4}$ Yards of Frize, - - -	at	3	6 ——			
4 Yards of fine Drab - -	at	15	6 ——			
$5\frac{7}{8}$ Yds. of superf. *Span.* Cloth,	at	18	6 ——			
31 Yds. of Livery Scarlet Cloth	at	13	0 ——			
				l. 46	0	$7\frac{1}{2}$

4. *James Webster,*

Bought of *William Grocer*, and Comp.

	C.	qrs.	lb.		l.	s.	d.	l.	s.	d.
2 Hhds. of Sugar,	17	2	27	at	1	13	10 *per* Cwt.			
Raisins, 3 Barrels,	12	1	19	at	1	14	5 —			
Tobacco, 1 Hhd.	4	0	12	at	4	19	4 —			
Rice, 1 Barrel, —	1	0	15	at	2	16	4 —			
Pepper, 1 Bag, —	1	3	19	at	3	12	4 —			
Brimstone, — —	2	1	19	at	1	19	1 —			
Bees-wax 4 Cakes, -	2	2	12	at	1	18	4 —			
								l. 91	9	$10\frac{1}{2}\frac{5}{8}$

5. *Edward Steward,*

Bought of *Francis Kiernan,*

	C.	qrs.	lb.		l.	s.	d.	l.	s.	d.
12 *Cheshire* Cheeses,	5	2	24	at	1	17	4 *per* C.			
45 *Gloucestershire* do.	4	2	10	at	1	12	6 ——			
40 *Irish* Cheeses, —	5	1	18	at	0	18	0 ——			
8 Firkins of Butter	7	2	0	at	1	5	6 ——			
7 Flitches of Bacon,	6	1	17	at	1	4	8 ——			
								l. 40	9	$0\frac{1}{2}\frac{3}{8}$

6. Sir

Sir *Michael Newton* to *Thomas Goldsmith*, Dr.

	oz.	pw.	grs.		s.	d.	
May 31. A Silver Set of Casters —	52	10	10	at	7	9	*per* oz.
June 7. Half a Doz. Soup Plates, —	85	14	15	at	6	6	
10. A Silver Tea pot and Lamp,	29	16	15	at	6	4	
8, 9. A large Punch-bowl, ———	67	0	16	at	6	10	
11. A Dozen of Silver Spoons,	33	11	10	at	6	2	

Nov. 6. A Dozen Desert Knives, Forks and Spoons, with a Shagreen-Case, — — } *l.* 40

l. 130 18 $3\frac{1}{8}$

7. *Thomas May to Wm. Weed*, Dr.

	C.	qrs.	lb.		s.	d.	
1 Hhd. best bright Tobacco,	5	2	0	at	0	$10\frac{1}{2}$	per lb.
1 Box of Oroonoko, — —	0	2	$19\frac{1}{2}$	at	0	$11\frac{3}{4}$	—
5 Bags of old *Spanish*, —	6	0	12	at	0	$4\frac{1}{8}$	—
$\frac{1}{2}$ Hogshead — — —	2	2	13	at	0	$5\frac{3}{8}$	—
2 Rolls — — — —	0	3	10	at	1	$5\frac{1}{8}$	—

l. 55 13 $5\frac{1}{4}$

8. Bought of *James Ervin*, 8 Bags of *Farnham* Hops, at $11\frac{1}{8}$*d.* *per* lb. *viz.*

	C.	qrs.	lb.
No. 1 ———	2	2	18
2 ———	2	3	10
3 ———	2	2	17
4 ———	2	0	0
5 ———	3	1	8
6 ———	3	1	3
7 ———	3	0	20
8 ———	2	2	7

l. 116 15 $3\frac{7}{8}$

CHAP. II.

Of estimating Imports *and* Exports, *&c.*

IN casting up the Amount of Goods bought, imported or exported, to the prime cost of such Goods we must add all the Charges upon them, in Order to fix the Price they stand us in, as will appear from the following:

Examples.

1. Suppose I import from *Rotterdam* 5 Bales of Paper each qt. 10 *Reams*, which, with Charges there, amounted to 29*l.* I pay Duty here 6*d.* *per* Ream, for Freight 19*s.* Porterage 1*s.* What doth it stand me in *per* Ream; and how must I sell it *per* Ream to gain 10 *per Cent?*

5 Bales
each 10 Reams,
In all 50 Reams, at 6*d.* *per* R. Duty
6*d.* ½ 2|5
l. 1 5 Duty

	l.	*s.*	*d.*
First Cost	29	0	0
Duty —	1	5	0
Freight	0	19	0
Porterage	0	1	0
Whole Cost *l.*	31	5	0

Re. 10)*l.* *s.* Re.
If 50 cost { 31 5 what cost 1
50 {
{ 5) 3 2 6

10)
If 100 gain 10 what 10) 0 12 6 cost *per* Re.
10 Divisor 0 1 3 gain by 1 Ream, at 10 *per Cent.* Wherefore I must sell it at *l.* 0 13 9 *per* Ream.

2. Suppose a Bale of Merchandize weighed 300lb; and cost *l.* 15 4 9; pays for Duty 2*d.* *per* lb; for Freight 25*s.* for Porterege home 1*s.* 6*d.* How much will 1lb of the said Merchandize stand me in? *Answ.* 15¼*d.*

3. Imported

3. Imported 4 Pipes of Oil, containing 480 Gallons, which cost me 5*s.* 5½*d. per* Gallon: Paid for Freight 4*s. per* Pipe, Duty 6*d. per* Gallon; Porterage 1*s. per* Pipe: What must I sell it for *per* Gallon to gain 12 *per Cent?*

Answer, 6*s.* 8$\frac{16}{23}$*d.*

4. Bought 150 Casks of Butter, Wt. neat 320*C.* 2*qrs.* 14lb, at 23*s.* 8*d. per* Cwt. Paid Custom 1*d. per* Cask; Porterage 2*d. per*; the Cellarage came to *l.* 1 15; Cooperage *l.* 1 14 4½; when I sell them for *l* 416 16 3, what do I gain upon the whole, *per* Cwt. and *per Cent?*

Answer, I gain *l.* 32 1 3 upon the whole; 2*s. per* Cwt and 8⅓ *per Cent.*

5. Bought 200 Carcasses of Beef, Wt. neat 850*C* 2*qrs.* at 6*s.* 6*d. per* Cwt. and salted them up in 400 Barrels which cost 2*s.* 9*d.* a piece; paid for 50 Barrels of Salt, at 20*s. per* Barrel; paid for salting, Labourers, &c. *l.* 4 0 1. Now I want to know what 1 Barrel stands me in?

Answer, 19*s.* 3¼*d.*

6. Shipped for *Bristol* 20 Packs of Bay-yarn, which cost me *l.* 408 10: paid for 50 Yards of Canvass, at 7*d. per* Yard; for packing 5*d. per* Pack; Porterage to the Quay 4*d. per* Pack; for Licence, Duty and other Port-Charges, *l.* 5 13 4; Lighterage, 11*s.* 2*d.* I desire to know what it stands me in *per* Pack on Board? *Answ. l.* 20 16 11⅓.

7. Imported from *Spain* 10 Tun of Wine, at 10*l. per* Hogshead; paid Duty here 1*s.* 1*d. per* Gallon; Freight 15*s. per* Tun; the Charges for Lighterage, Porterage, &c. came to *l* 11 9: A Storm arising, one Pipe containing 126 Gallons was thrown overboard: What doth the Remainder stand me in *per* Gallon; how must I sell it *per* Hogshead to gain 10 *per Cent*; and what do I gain by the whole at that Rate?

Answ. The Remainder 4*s.* 7*d. per* Gal.; I must sell it at *l.* 15 17 7½ *per* Hhd; and gain by the whole *l.* 54 17 3.

CHAP. III.

Of Allowances *on the* Weight *of* Goods *called* TARE *and* TRETT.

TARE is the Weight of the Cask, Barrel, Box, Wrapper, &c. *viz.* whatever Goods are packed in, or an Allowance in consideration thereof. *Trett*

Trett is an allowance to Retailers on Account of Waste, or the small draughts they sell by.

Gross-Weight is the Weight of the Commodity together with that in which it is packed without any Deduction.

Neat-Weight is the Remainder after all Allowances are deducted

I. OF INVOICE TARE.

Rule.

Add the Gross-weights into one Sum, and the Tares into another. Then subtract the total Tare from the whole Gross, and the Remainder is the Neat-weight.

Examples.

1. What do 4 Barrels of Indigo come to, at 3*s.* 4*d.* *per* lb, No and Weight as follows, *viz.*

	C.	qrs.	lb		lb
No 1	4	1	10	Tare	36
2	3	3	02		29
3	4	0	19		32
4	4	0	00		35
Total Gross	16	1	03		132 T. Tare

16
16
1628
3

1823lb Gross
132lb Tare

1691lb Neat 3*s.* 4*d.*

3*s.* 4*d.* is $\frac{1}{6}$—*l.* 281 16 8 *Answ.*

2. What do 6 Hogsheads of Tobacco come to, Weight Gross 35*C.* 0*qrs.* 9lb; Tare of all 556lb, at *l.* 4 15 10 *per* Cwt. *Answer*, *l.* 144 6 1$\frac{27}{56}$.

3. Bought

3. Bought 2 Hogsheads of Sugar, at 35*s.* *per* C. Neat, *viz.*

	C.	qr.	lb		lb	
No 1 ——	11	1	17	Tare	112	} *Anf.* *l.* 38 18 $5\frac{1}{4}$
2 ——	12	2	00	——	74	

4. Sold 10 Hhds of Tobacco, at $7\frac{1}{2}$*d.* *per* lb Neat, N° and Weight as follow, *viz.*

	C.	qrs.	lb		C.	qrs.	lb
N° 1 ——	6	3	17	Tare	0	3	17
2 ——	6	3	19	—	1	1	14
3 ——	6	2	14	—	1	0	02
10 ——	7	2	24	—	1	0	07
14 ——	6	3	22	—	0	3	24
16 ——	6	2	27	—	0	2	17
17 ——	7	3	04	—	1	0	09
19 ——	6	3	04	—	1	0	04
20 ——	7	2	07	—	0	3	17
25 ——	9	3	02	—	0	2	27

Anfwer, *l.* 224 1 3

II. When the Tare or Trett is fo much *per* Bag, Bale, &c. multiply the Tare of one by the Number of Bags, Bales, &c. the Product is the whole Tare.

5. What's the Amount of 16 Hhds of Tobacco, qt. Grofs 86*C.* 2*qrs.* 14lb; Tare *per* Hhd. 100lb; at *l.* 3 15 10 *per* Cwt.?

Grofs	86	2	14
Tare	14	1	4
Neat	72	1	10

Mult. 16 Hhds.
by 100lb, Tare of each

112)1600(14 1 4 whole Tare
112
———
480
448
———
28) 32
28
———
4

C.	qr.	lb				
72	1	10	at	3	15	10
						12
				45	10	0
						6
				273	0	0
1 *qr.* is	$\frac{1}{4}$			0	18	$11\frac{1}{2}$
8lb is	$\frac{1}{4}$			0	5	5
2lb is—	$\frac{1}{4}$			0	1	$4\frac{1}{4}$
			l.	274	5	$8\frac{3}{4}$

6. 70

6. 70 Bales of *Smyrna* Silk, each 317lb Groſs; Tare *per* Bale 16lb at 16*s.* 8*d.* *per* lb Neat?

Anſwer, *l.* 17558 6 8.

7. What's the Value of 14 Hhds of Tobacco, weighing Groſs 89*C.* 2*qrs.* 17lb; Tare 100 *per* Hogſhead, at $9\frac{1}{4}$*d.* *per* lb Neat? *Anſwer*, *l.* 351 0 $9\frac{1}{4}$.

8. Sold 4 Caſks of Indigo, Wt. Groſs 18*C.* 2*qrs.* Tare 37lb *per* Caſk, at 4*s.* 6*d.* *per* lb, what do they Amount to? *Anſwer*, *l.* 432 18 0.

9. What's the Amount of 4 Hogſheads of Tallow, *viz.*

	C.	qrs.	lb	
No 1 ———	9	3	24	Tare 3*qrs.* 6lb *per* Hhd.
2 ———	10	2	16	at *l.*20 10 *per* Ton.
3 ———	11	0	12	
4 ———	9	3	1	*Anſwer*, *l.* 39 4 $3\frac{1}{2}$.

III. When the Tare or Trett is ſo much *per* Cwt. Groſs.

Divide the Pounds Tare into Aliquot Parts of a Cwt. and take that Part out of the Groſs, the Quotient is the whole Tare, which ſubtract from the Groſs, &c.

Otherwiſe:

If the Tare or Trett be a ſmall Number as 1, 2, 3, multiply the Cwt. Groſs by the Pounds Tare or Trett, and for the Quarters and Pounds take Parts of the Tare or Tret.

10. What coſt 12 Butts of Currants, Groſs 7*C.* 1*qr.* 10lb each Butt, Tare 16lb *per* Cwt. at 32*s.* 6*d.* *per* Cwt. Neat?

	C.	qr.	lb.			*l.*	*s.*	*d.*	
	7	1	10						
			12						
Tare *per* C.	88	0	8	Groſs,					
16lb is $\frac{1}{7}$	12	2	9	Tare,					Or
	75	1	27	Nt. at		1	12	6	2*qrs.* $\frac{1}{2}$ 1 12 6
10*s.* is $\frac{1}{2}$*l.*	37	10							
2*s.* 6*d.* $\frac{1}{4}$	9	7	6		1 *qr.* $\frac{1}{4}$	0	8	$1\frac{1}{2}$	From 8) 16 3
	0	15	$11\frac{1}{4}$		16lb $\frac{1}{7}$	0	4	$7\frac{1}{4}$	*qr.* lb
					8 $\frac{1}{2}$	0	2	$3\frac{3}{4}$	1 27 C.$\frac{1}{56}$7)2 $0\frac{3}{8}$
l.	122	13	$5\frac{1}{4}$		2 $\frac{1}{4}$	0	0	$6\frac{3}{4}$	
					1 $\frac{1}{2}$	0	0	$3\frac{1}{2}$	Take 0 $3\frac{1}{2}$
					l.	0	15	$11\frac{1}{4}$	15 $11\frac{1}{4}$

11. What is the Price of 30 Barrels of Figs, Wt. Groſs 75*C.* 3*qrs.* 14lb, Tare 14lb *per* Cwt. at 18*s.* 6*d.* *per* Cwt. Neat? *Anſwer*, *l.* 61 8 2 $\frac{23}{32}$.

12. 8 Bags of Pepper, Wt. Groſs 21*C.* 3*qrs.* 15lb, Tare 4lb *per* C. at 11$\frac{3}{4}$*d.* *per* lb neat? *Anſw.* *l.* 115 14 2$\frac{79}{112}$.

13. 50 Caſks of Butter, Weight Groſs 202*C.* 3*qrs.* 14lb, Tare 20lb *per* C. at 19*s.* *per* C. Neat? *Anſwer*, *l.* 158 6 8$\frac{33}{56}$.

14. What come 4 Hogſheads of Sugar to, Weight 43*C.* 3*qrs.* 21lb Groſs, Tare 12lb *per* C. at *l.* 2 15 4 *per* C. Neat? *Anſwer*, *l.* 108 10 8$\frac{37}{56}$.

OF TRETT.

TRETT in *London* is an Allowance of 4lb, in 104lb, after the Tare is deducted, on Goods ſubject to Waſte, which is $\frac{1}{26}$ Part of the Remainder.

In *Cork* they allow 1lb out of every Cwt. of the Groſs Weight of all Goods, except Beef, Butter, Hides and Wool, and on theſe they make the following Allowances:

Butter, 2lb, on every large Caſk;

Beef, 8lb, *per* Carcaſs;

Raw Hides, 4lb, *per* Piece;

Wool, 8lb, for every 20 ſtone, *viz.* $\frac{1}{2}$ Stone in 20 Stone is $\frac{1}{40}$; but in *Dublin*, and parts adjacent, they allow 8lb, for every 3Cwt. or 21 Stone, which is $\frac{1}{42}$ after the Tare is deducted.

1. Two Hogſheads of Tallow weigh as followeth, Trett 1lb *per* Ct. out of the groſs, and at 30*s.* *per* Ct. what does it come to? *Anſwer*, *l.* 29 5 1$\frac{17}{28}$.

	C.	qr.	lb.		C.	qr.	lb.
N° 1 wt.	10	1	11	Tare	0	3	20
2 wt.	11	0	17		0	3	14
Groſs	21	2	00		1	3	6
1 *per* C. Trett	0	0	$21\frac{1}{2}$				
	21	1	$6\frac{1}{2}$				
Tare	1	3	6				
Neat	19	2	$0\frac{1}{2}$				
at	30*s*.	*per*	Ct.				

	570	
2 *qrs*. is $\frac{1}{2}$	15	
$\frac{1}{2}$ *lb*. is $\frac{1}{112}$	0	$1\frac{17}{28}$
	58 | 5	$\frac{17}{28}$
Anſwer, *l*. 29	5	$1\frac{17}{28}$

2. Sold 4 Hogſheads of Sugar, weighing as follows:
N° 1, Wt. 7*C*. 3*qrs*. 16*lb*. Tare 3*qrs*. 20*lb*.
2, 8*C*. 0*qrs*. 10*lb*. Tare 3*qrs*. 24*lb*.
3, 7*C*. 2*qrs*. 20*lb*. Tare 3*qrs*. 27*lb*.
4, 8*C*. 2*qrs*. 18*lb*. Tare 3*qrs*. 25*lb*.
Trett lb *per* Ct. and at 35*s*. 4*d*. *per* Ct. how much does it amount to? *Anſwer*, *l*. 49 15 $6\frac{195}{292}$.

3. A Merchant has bought 4 Hhds. of Copperas, weight as follows, *viz*.
N° 1, 10*C*. 2*qrs*. 4*lb*. Tare 3*qrs*. 4*lb*.
2, 11*C*. 0*qrs*. 10*lb*. Tare 3*qrs*. 10*lb*.
3, 12*C*. 1*qr*. 0*lb*. Tare 3*qrs*. 14*lb*.
4, 11*C*. 2*qrs*. 14*lb*. Tare 3*qrs*. 18*lb*.
Trett 1lb *per* Ct. and at 8*s*. 6*d*. *per* Ct. how much does it come to? *Anſwer*, *l*. 17 14 $3\frac{79}{112}$.

4. 4 Caſks of Raiſins Weight as follows.
N° 1, 1*C*. 3*qrs*. 25*lb*. Tare 0*qrs*. 21*lb*.
2, 1*C*. 3*qrs*. 20*lb*. Tare 0*qrs*. 24*lb*.
3, 2*C*. 1*qr*. 16*lb*. Tare 0*C*. 1*qr*. 3*lb*.
4 1*C*. 3*qrs*. 23*lb*. Tare 0*C*. 0*qrs*. 25*lb*.
Trett 1lb. *per* Ct. and at $30\frac{1}{2}$*s*. *per* Ct. what does it amount to? *Anſwer*, *l*. 11 0 $7\frac{15}{16}$.

5. What will 3 Bales of Coffee come to, Weight,
N° 1, 2*C.* 3*qrs.* 12*lb.* Tare 16*lb.*
2, 3*C.* 1*qr.* 20*lb.* Tare 19*lb.*
3. 3*C.* 1*qr.* 24*lb.* Tare 18*lb.*
Trett 1lb. *per* C. and at *l.* 18 10 *per* C.?
Answer, *l.* 170 0 $2\frac{2}{3}\frac{3}{8}$.

I. When the Price is given *per* lb. Neat and the Trett 1lb. *per* Cwt. write the Cwt. Gross three Times putting the Unit-Figure of the second Line under the Tens of the first, and the Units of the third under the Tens of the second: Then for the odd Quarters write $27\frac{3}{4}$ for 1qr. $55\frac{1}{2}$, for 2 qrs. and $83\frac{1}{4}$ for 3qrs. Add them into one Sum, and then the Trett is taken away. From that Sum deduct the *lb.'s* Tare (if any) and the remainder is the Pounds Neat.

6. To how much come the following 2 Hhds. at 1*s.* 8*d.* *per* lb.

	C.	*qrs.*	*lb.*
N° 1 ——	2	3	10
2 ——	3	2	18
	6	2	0

6
$655\frac{1}{2}$
$721\frac{1}{2}$
Tare 32
$689\frac{1}{2}$ at 1*s.* 8*d.*

s.	*d.*			
1	$8\frac{1}{12}$	57	8	4
				10
		l. 57	9	2

7. A Merchant has sold 3 Bags of Pepper, *viz.*
N° 1, weighing 3*C.* 2*qrs.* 0*lb.*
2, 4*C.* 1*qr.* 7*lb.*
3, 3*C.* 3*qrs.* 21*lb.*
Trett 1lb. *per* C. and Tare 40lb. for each Bag, at $14\frac{3}{4}d.$ *per lb.* Neat, I demand how much it will come to?
Answer, *l.* 72 15 $7\frac{11}{18}$.

8. Sold

8. Sold 4 Casks of Indigo, wt. Gross 18*C.* 2*qrs.* 0*lb.* Trett 1 *per Cent.* Tare 37lb. *per* Cask, and at 4*s.* 6*d.* *per* lb. what does it amount to? *Answ.* *l.* 428 14 9.

9. Twelve Casks of Merchandise, *wt.* 306*C.* 3*qrs.* 0*lb.* Trett 1 *per* *C.* Tare 35 lb *per* Cask, and $15\frac{1}{2}$*d.* *per* lb. what does it come to? *Answ.* *l.* 2171 17 $9\frac{3}{8}$*d.*

10. Three Bags of Cocoa, Weight Gross 10*C.* 1*qr.* 14*lb.* Trett 1 *per* *C.* Tare 7lb. *per* Bag, at $9\frac{3}{4}$*d.* *per* lb. what does it come to? *Answ.* *l.* 45 18 $8\frac{1}{4}\frac{3}{16}$.

11. What will 4 Hogsheads of Tallow come to?
No 1 weight 9*C.* 3*qrs.* 24*lb.*
2 weight 10*C.* 2*qrs* 16*lb.*
3 weight 11*C.* 0*qrs.* 12*lb.*
4 weight 9*C.* 3*qrs.* 4*lb.*

Trett 1 *per* *C.* and Tare 3*qrs.* 6*lb.* *per* Hhd. and at 20*l.* 10*s.* *per* Tun? *Answ.* *l.* 38 17 $3\frac{1}{4}\frac{5}{12}$.

12. How many *Cwt.* Neat in 12*C.* 3*qrs.* 12*lb.* Gross. Tare 2lb. *per* C. Trett 4lb. in 104?

	C. *qrs.* *lb.*	But if the lb. Neat be required.
12 2 14	12 3 12	
4		12 3 12
qr. lb.	24 for 12 *C.*	12
26)50(1 26	$\frac{3}{4}$ 1 $\frac{1}{2}$ for 3*qrs.*	12 26) 1414 (54
26	$\frac{1}{7}$ 0 $\frac{3}{14}$	1284 130
		12
24	0 $25\frac{5}{7}$ Tare,	114
28		1440 104
	12 2 $14\frac{2}{7}$	$25\frac{5}{7}$ Tare
196	1 26 Trett.	10
49		$1414\frac{2}{7}$
Answ.	12 0 $16\frac{2}{7}$	$\frac{1}{26}$ 54 Trett.
686		
52	*Answer,*	$1360\frac{2}{7}$
166		
156		
10		

4 Bar-

13. 4 Barrels of *Spanish* Tobacco, *viz.*

```
          C. qrs. lb.
No.  4——1   0   4 ⎫ Tare 14lb per C.  Trett 4lb per
     7——0   3  25 ⎬   104lb at 9½d. per lb Neat.
     9——1   0   5 ⎪
    13——0   2  26 ⎭     Answer, l. 14 2 4 49/52.
```

14. Bought 3 Packs of Wool, Weight, *viz.*

```
               C. qrs. lb.
       No. 1—3   1   12 ⎫ Tare 30lb. per Pack.
           2—3   3   07 ⎬ Trett 8lb. for every 20 Stone,
   30      3—3   2   15 ⎭ at 10s. 6d. per Stone ?
    3        ——————————        Answer, l. 35 16 7½
   —qrs. lb. 10  3   6
 28)90(3  6      3   6 Tare
    84       ——————————
    —        10       lb.  C.
    6        7 Stone at 16==1
lb.  Sto.    ————
 8 of 20 is 4|1/10  70 Stone
             1   12lb.
             ————————    s.  d.
             68   4 at 10   6
             ————————   —————
 10s. is ½   34  4lb. ¼ 2 7½
 6d. is 2|1/10  1  14
              0   2  7½
            ——————————
 Answer, l. 35  16  7½
            ——————————
```

15. Bought 5 Packs of Wool, Weight, *viz.* No. 1. 4*C.* 2*qrs.* 15*lb* ; No. 2. 4*C.* 2*qrs.* 0lb. ; No. 3 3*C.* 3*qrs.* 21*lb.* ; No. 4 3*C.* 3*qrs.* 14*lb.* ; No. 5. 4*C.* 0*qrs.* 14*lb.* Tare 28lb *per* Pack, Trett 8lb. for every 3*C.* at 11*s*, 6*d.* *per* Stone ; how much doth it come to ?

Answer, *l.* 77 17 $7\frac{17}{38}$.

16. INVOICE

16. INVOICE of 12 Bags of Wool bought at *Clonmel* for Account of *E. W.* of *Dublin*, *viz.*

		C.	*qrs.*	*lb.*	
	No. 1	5	2	24	Tare 29lb. *per* Bag,
WOOL	2	2	1	00	Trett 8lb. for every 20
E. W.	3	7	1	18	Stone at 10*s.* 9*d.* *per*
	4	4	3	22	Stone.
	5	6	2	13	
	6	5	1	19	*Answer*, *l.* 243 1 4.
	7	7	2	14	
	8	5	3	24	
	9	6	1	17	
	10	4	2	26	
	11	5	3	13	
	12	6	1	19	

17. INVOICE of 15 Bags of Wool bought at *Mullingar* for Account of *A. B.* of *Corke*, Merchant, *viz.*

		C.	*qrs.*	*lb.*		*C.*	*qrs.*	*lb.*
WOOL	No. 1	4	3	16	No. 9	7	1	11
A. B.	2	5	1	12	10	4	3	26
	3	3	3	25	11	5	2	19
Tare 30lb *per* Bag	4	6	1	24	12	6	1	08
Trett 8lb for every	5	7	2	04	13	6	2	05
3*C.* at 10*s.* 3*d.*	6	5	3	20	14	7	1	18
per Stone?	7	6	2	12	15	7	2	12
Answ. *l.*311 13 8⅔	8	6	1	14				

18. *London*, 17th of *Sept.* 1796.

Stuart, *Webster* and Comp.

Bought of the *East India* Company at 4 Months.

Pepper 2 Lots, *viz.*

	C	*qrs.*	*lb.*		lb.
No. 17—10 Bags qt.	27	1	18	Tare	150
20—10	24	3	24	——	138
Gross					
Tare					
Neat				at 10⅜*d.* *per* lb.—£.	

Redwood, 2 Lots, *viz.*

		Ton	*C.*	*qrs.*
No. 47—120	Sticks	10	13	3
48—100	——	11	12	0
——		——	——	*l s.*
				at 3 7 *per* Ton—£.

Wormseed, 3 Bales,

	C.	*qrs.*	*lb.*		*qrs.*	*lb.*
No. 18—	3	1	10	Tare	1	14
24—	4	2	00	——	1	16
37—	2	3	19	——	1	13
Gross						
Tare						
Neat				at 13½*d.* *per* lb.——£.		

Answer, l. 376 8 7$\frac{9}{16}$.

19. *Belfast*, 23*d.* of *September*, 1796.

Peter Paydown and Company,

Bought of *Titus Tradewell* for ready Money, Cotton, 14 Bags, *viz.*

	C.	*qrs.*	*lb.*		*C.*	*qrs.*	*lb.*
No. 1—qt.	3	1	7	No. 17—	2	3	16
2——	2	3	0	24—	3	1	10
3——	2	3	5	28—	3	0	27
4——	3	0	15	30—	2	3	4
	11	3	27		12	1	1
	12	1	1				
	24	1	0 Total Gross				
	0	3	13 Tare allow'd				
	23	1	15 Suttle 2619lb.				
			Trett 100				

2519 at 14d. *per* lb.—£.

More,

More, *viz.*

		C.	*qrs.*	*lb.*	
No	30	2	3	12	Damaged
	31	3	0	10	
	32	3	1	26	
	33	3	2	08	
	34	2	2	07	
	35	1	3	10	

Groſs
Tare 0 2 11

Suttle lb
Trett $\frac{1}{26}$

Neat lb at 4*d. per* lb—£.

Anſwer, l. 177 2 0$\frac{4}{13}$

CHAP. IV.

Of Eſtimating the Allowances, Premiums *or* Rates *per Cent. or on the* 100*l.*

THE Allowances or Premiums eſtimated at ſo much *per Cent.* are *Commiſſion, Inſurance, Brokerage, Intereſt, Diſcount,* and *Exchange* between *England* and *Ireland.*

Commiſſion is a Præmium allowed by the employer to his Factor for tranſacting his Buſineſs abroad.

Inſurance is paid by one Merchant to another or to a Company for inſuring his Ships, Goods, *&c.* that is, engaging to make good to him the Value inſured, if the ſame be loſt or damaged.

Brokerage is an allowance to the Broker, who is a Perſon employed to find out Cuſtomers for Merchandiſes and the Contrary.

Exchange, Intereſt and *Diſcount* will be treated of in their reſpective places.

Now in these Cases we have given the Rate *per Cent.* to find the Allowance upon a given Sum at the same Rate: that is, three Numbers given to find a fourth Proportional, *viz.* *l.*

As 100 : its Rate : : so is the given Sum : to its Rate or the proportional Allowance.

Case I.

When the Rate or Præmium is a whole Number, and likewise the given Sum, on which the Præmium is to be found.

This is already taught (see P. 85)

Case II.

When the given Sum (whereof the Præmium is to be found) is of divers Denominations, multiply it by the Rate or Præmium of a 100*l.* and divide by 100.

Examples.

1. What is the Commission on 417*l.* 16*s.* 8*d.* at 2 *per Cent?* *Answ. l.* 8 7 $1\frac{3}{5}$.
2. Sold Goods for *A. B.* to the Amount of 153*l.* 2*s.* 6*d.* and for Commission and Risque of Debts am to receive 4 *per Cent*, what doth it amount to? *Answ. l.*6 2 6.
3. What is the Exchange of 750*l.* 18*s.* 8*d.* *English* Money, at 7 *per Cent?* *Answ. l.* 52 11 $3\frac{17}{25}$.
4. How much is the Interest of 300*l.* 10*s.* at 8 *per Cent.?* *Answ. l.* 24 0 $9\frac{3}{5}$.

Case III.

When the Rate is a Fraction.

Multiply the given Sum thereby, *viz.* Divide it by the Denominator of the Rate, &c. as before.

5. What is the commission on *l.* 1026 17 4 at $\frac{1}{2}$ *per Cent.?*

	l.	*s.*	*d.*
	2)1026	17	4
			$\frac{1}{2}$
$\frac{1}{2}$—	5|13	8	8
	20		
	2|68		
	12		
	8) 24|6		
	100|25		

Answ. *l.* 5 *s.* 2 *d.* $8\frac{6}{25}$.

6. How

6. How much is the Brokerage of 846*l.* 19*s.* at $\frac{1}{4}$ *per Cent?*
Answer, *l.* 2 2 4$\frac{17}{100}$.
7. Negotiated Bills for Account of *A. C.* to the Amount of *l.* 1538 13 6$\frac{1}{2}$, what is my Commission at $\frac{3}{8}$ *per Cent.?*
Answer, *l.* 5 15 4$\frac{3}{3}\frac{19}{20}$.
8. What is the Brokerage of *l.* 700 14 6 at 4*s. per Cent.?*
Answ. l. 1 8 0$\frac{37}{250}$.
9. What must I pay my Broker when he sells Goods to the Value of *l.* 500 10 7 at 7*s* *per Cent.?*
Answ. l. 1 15 0$\frac{880}{1000}$.

Case IV.

When the Rate is a mixt Number.

For the Integral Part multiply the given Sum by *Case* 2. and for the Fraction, *per* last: add these Products together, and proceed as before.

Examples.

10. What is my Commission on *l.* 199 3 6 at 2$\frac{1}{2}$ *per Cent.?*

```
           2½
      ─────────
      398  7  0
       99 11  9
      ─────────
     4|97 18  9
       20
      ───
     19|58        Answer,
       12     l. 4 19 7 1/100 or 1/20.
      ───
      7|05
```

11. I have sold Goods for Account of *Thomas Jones* amounting to 536*l.* 10*s.* what is my Commission at 2$\frac{1}{2}$ *per Cent?*
Answ. l. 13 8 3.
12. What is the Commission on 1009*l.* 18*s.* at 2$\frac{1}{4}$ *per Cent?*
Answ. l. 22 14 5$\frac{23}{50}$.
13. Insured 427*l.* 13*s.* on the Ship *Sea-horse* for the present Voyage to *Barbadoes*; Insurance at 8$\frac{1}{4}$ *per Cent.* what doth it amount to? *Answ. l.* 35 5 7$\frac{47}{100}$

14. Bought by Order and for Account of *Jaques Durand* of *Bourdeaux*, 400 Barrels of Beef, which cost *l.* 390 17*s.* 6*d.* which I ensured at $5\frac{3}{4}$ *per Cent.* I demand the Insurance; my commission on the same at $2\frac{1}{2}$ *per Cent.*; and for Insuring the same at $\frac{1}{2}$ *per Cent.*?

Answer, Insurance 22*l* 9*s.* $6\frac{1}{40}$*d.*; Commission at $2\frac{1}{2}$— 9*l.* 15*s.* $5\frac{1}{4}$*d.* at $\frac{1}{2}$—1*l.* 19*s.* $1\frac{1}{20}$*d.*

Method 2 by *Practice.*

Divide the Rate into Aliquot Parts of 100, and divide the given Sum by the Denominators of the Parts, &c.

Examples.

I demand the Interest of 264*l.* 16*s.* 3*d.* at 5 *per Cent.*?

	l.	*s.*	*d.*
of 100—5*l.* $\frac{1}{20}$	264	16	3
	l. 13	14	$9\frac{3}{4}$

What is the Commission of *l.* 1026 17 4 at $\frac{1}{2}$ *per Cent.*?

	l.	*s.*	*d.*
$\frac{1}{2}$ of 100 is $\frac{1}{200}$	2)1026	17	4
	10)513	8	8
	10)51	6	$10\frac{4}{10}$
	5	2	$8\frac{6}{25}$

Or thus,

	10|26	17	4
$\frac{1}{200}$	*l.* 5	2	$7\frac{1}{5}$=1026÷200
			$1\frac{1}{25}$=17*s* 4÷200
	l. 5	2	$8\frac{6}{25}$

I divide 1026 by 200 thus, Cut off the two Figures 26 for the Cyphers in the Divisor, and divide them by 10.

	l.	*s.*	
	100|9	18 at $2\frac{1}{4}$ *per Cent.*	
2 is $\frac{1}{50}$	20	3	$10\frac{26}{50}$
$\frac{1}{4}$ -- $\frac{1}{8}$	2	10	$5\frac{47}{50}$
	l. 22	14	$5\frac{23}{50}$

2 $\frac{1}{2}$ is $\frac{1}{40}$.

In

In like Manner may all the foregoing Examples be solved, which I leave for the learner's exercise.

Method 3 By *Decimals.*

By the Application of Decimals we may easily discover the proportionable Rate of 1*l.* which is a common Multiplier, to any given Sum at that Rate.

A TABLE

of the Rates of 1*l.* at any Rate *per Cent.*

Rate *per Cent.*	Rate of 1*l.*	Rate *per Cent.*	Rate of 1*l.*
2	.02	4	.04
2 $\frac{1}{4}$	.0225	4 $\frac{1}{4}$	.0425, &c.
2 $\frac{1}{2}$	.025	5	.05
2 $\frac{3}{4}$	.0275	6	.06
3	.03	7	.07
3 $\frac{1}{4}$	.0325	8	.08
3 $\frac{1}{2}$	.035	9	.09
3 $\frac{3}{4}$	.0375	10	.1 &c.

The Use.

These Rates of 1*l.* are common Multipliers for any Sum given at the correspondent Rate *per Cent.* (the lesser Denominations being first reduced to the Decimal of 1*l.*) which will plainly appear from the following

Examples.

I demand the Annual Interest of 264*l.* 16*s.* 3*d.* at 5 *per Cent.*

l.	*s.*	*d.*	
264	16	3	=264.8125
			.05 Rate of 1*l.*
			13.240625
l. 13	14	$9\frac{3}{4}$	

What

What is the Commission on *l.* 199 3 6 at $2\frac{1}{2}$ *per Cent.*

```
  199.175
     .025
  -------
   995875
  398350
  -------
 4.979375
  -------
```

Answ. l. 4 19 7

Thus likewise may all the foregoing Examples be resolved.

CHAP V.

INTEREST.

ANY Sum of Money being lent out upon consideration of receiving the same again, with a Præmium from the Borrower for the Use of it a certain Time, is said to be put out at Interest; and the Interest is usually rated by the 100*l.*

The Sum lent out is called the *Principal.*

Interest is the Præmium or Allowance for the Use of the Principal.

The *Rate* is the Interest of 100*l.* for one Year.

The *Amount* is the Principal and its Interest together.

Interest is Simple or Compound.

Simple Interest is that which arises from the Principal only: As if 100*l.* were lent for two Years, the Simple Interest thereof for the two Years will be 12*l. viz.* 6*l.* due at the first Year's End, and 6*l.* due at the second Year's End.

Compound Interest is that which arises from the Amount of the preceding Year, *viz.* from the Principal and the Interest likewise as it becomes due; So if 100*l.* be lent and forborne two Years at Compound Interest, The Amount at the first Years End 106*l.* becomes a new Principal; that is, Interest must be paid the second Year not only for the 100*l.* lent out, but likewise for the 6*l.* Interest due thereupon.

SIMPLE

SIMPLE INTEREST.

Case I.

To find the Intereſt of any given Sum for 1 Year having the Rate given.

By having the Rate given we have manifeſtly this Proportion, 100: the Rate: : the given Sum; to its intereſt, which is ſolved in all Caſes by Chap. IV.

Examples.

1. What is the Intereſt of *l.* 270 10 6 at the Rate of 5 *per Cent?* *Anſwer, l.* 13 10 $6\frac{3}{10}$.

l.	*s.*	*d.*		Or thus,	Or thus,
270	10	6		270 10 6	270,525
		5	*l.*		,05
13|52	12	6	5 of 100, is $\frac{1}{20}$.	13 10 $6\frac{6}{20}$	13, 52625
20					*l.* 13 10 $6\frac{3}{10}$
10|52					
12					
6|30					

2. What is the Intereſt of 300*l.* 10*s.* for 1 Year, at the Rate of 8 *per Cent. per Ann.?* *Anſw. l.* 24 0 $9\frac{3}{5}$.

3. Tell me the Intereſt of *l.* 344 17 6 for 1 Year, at the Rate of 6 *per Cent. per Ann.?* *Anſw. l.* 20 13 $10\frac{1}{5}$.

4. What is the Intereſt of *l.* 246 18 10 for 1 Year, at 3 *per Cent. per Ann.?* *Anſwer, l.* 7 8 $1\frac{49}{50}$.

5. What is the Intereſt of 220*l.* for a Year, at 4 *per Cent. per Ann.?* *Anſwer, l.* 8 16.

Case II.

To find the Intereſt of any Sum for any Number of Months, Years, or Years and Months.

Rule.

1. Find the Intereſt of the given Sum for 1 Year.

2. For

2. *For Years.*

Multiply the Intereſt for 1 Year by the Number of Years given.

3. *For Months.*

Divide the Months into Aliquot Parts of a Year, and divide the Intereſt of 1 Year by the Denominator or Denominators, *&c.* as in *Practice.*

Or thus:

Find the Rate or Intereſt of *l.* 100 for the given Time. Then it will be

100 : its Intereſt for the given Time : : Any Sum : its Intereſt for the ſame Time.

Examples.

6. Caſt up the Intereſt of *l.* 348 15 for 18 Months, at 7 *per Cent.*? *Anſwer, l.* 36 12 $4\frac{1}{2}$.

l.	*s.*		*l.*	*s.*	*d.*		
348	15		24	8	3 for 12 Mo.		348.75
	7	$\frac{1}{2}$	12	4	$1\frac{1}{2}$—6 ditto.		.07
24|41	5		36	12	$4\frac{1}{2}$—18 Mo.	*Yr.*	
20						1	=24.4125
8|25						$\frac{1}{2}$	=12 20625
12							36.61875
3|00							36 12 $4\frac{1}{2}$

Or thus,

348 15 for 18 Mo. at 7 *per Cent.*

7 Rate for 12 Mo.

6 Mo. $\frac{1}{2}$	3	10	6
	10	10	18
	348	15	
		$10\frac{1}{2}$	
	3487	10	
	174	7	6
	36|61	17	6
	20		
	12|37		
	12		
	4|50		
	4		
	2|00		

7. Find

7. Find the Intereſt of 1000*l.* for 21 Months, at 8 *per Cent?* *Anſwer*, 140*l.*

8. Tell me the Intereſt of 1090*l.* for 17 Months, at 6 *per Cent?* *Anſwer*, *l.* 92 13.

9. How much is the Intereſt of *l.* 175 10 6 for 1 Year and 7 Months, at 6 *per Cent. per Annum?*

Anſwer, *l.* 16 13 $5\frac{97}{100}$.

10 What is the Intereſt of 514*l.* for 1 Year $7\frac{1}{2}$ Months, at 5 *per Cent. per Annum?* *Anſw* *l.* 41 15 3.

11. Caſt up the Intereſt of *l.* 886 16 for 1 Year $11\frac{1}{4}$ Months, at 4 *per Cent. per Ann?* *Anſw.* *l.* 69 9 $3\frac{21}{25}$.

12. What is the Intereſt of *l.* 479 18 for 2 Years, at $4\frac{1}{2}$ *per Cent. per Annum?* *Anſw.* *l.* 43 3 $9\frac{21}{25}$.

13. What is the Intereſt of *l* 571 15 for 8 Months, at 6 *per Cent. per Annum?* *Anſw.* *l.* 22 17 $4\frac{4}{5}$.

14. What is the Intereſt of 300*l.* for $5\frac{3}{4}$ Years, at $3\frac{3}{4}$ *per Cent. per Annum?* *Anſwer*, *l.* 64 13 9.

A Contraction.

Since 5*l.* is $\frac{1}{20}$ of 100, whenever the Intereſt of 100 is 5; the Intereſt of any Sum at the ſame Rate will be $\frac{1}{20}$ Part of itſelf. But the Intereſt of 100 is 5.

$$\text{at}\left\{\begin{matrix}5\\6\\4\\3\end{matrix}\right\}\textit{per Cent.}\ \text{for}\left\{\begin{matrix}12\\10\\15\\20\end{matrix}\right\}\text{Months.}$$

Wherefore when any Sum at the ſaid Rates and Time is given, divide it by 20 and the Quotient is the Intereſt required.

Examples.

15. What is the Intereſt of *l.* 379 15 for 12 Months, at 5 *per Cent.?*

l *s.*	For the odd Shilling and Pence value every 10*s.* equal to 6*d.* and leſſer Sums in Proportion, *i.e.* 10=6*d.* 6*s.* 8*d.*=4*d.* 5*s.*=3*d.* 3*s.* 4*d.*=2*d.* 2*s.* 6*d*=$1\frac{1}{2}$*d.* 1*s.* 8*d*=1*d.* 1*s.* 3*d.* =$\frac{3}{4}$*d.* 10*d.*=$\frac{1}{2}$*d.* 5*d*=$\frac{1}{4}$*d.*
2|0) 37|9 15	
Anſw. *l.* 18 19 9	

16. What is the Intereſt of *l.* 416 12 6 for 10 Months, at 6 *per Cent. per Annum?* *Anſwer*, *l.* 20 16 $7\frac{1}{2}$.

17. What

17. What is the Intereſt of *l.* 427 13 9 for 20 Months, at 3 *per Cent per Annum?* *Anſwer*, *l.* 21 7 $8\frac{1}{4}$.

18. Find the Intereſt of *l.* 927 11 3 at 4 *per Cent.* for 15 Months? *Anſwer*, *l.* 46 7 $6\frac{3}{4}$.

Hence, to find the Intereſt of a given Principal, for any other Time.

Rule.

Take Parts for the Time required, out of the Time correſpondent to the given Rate.

19. What is the Intereſt of *l.* 279 11 for 4 Months, at 5 *per Cent, per Annum?*

	l.	*s.*		
2|0)	27|9	11		
of 12 Mo. 4 is $\frac{1}{3}$	13	19	$6\frac{3}{5}$	Int. for 12 Months.
Anſwer, *l.*	4	13	$2\frac{1}{5}$	Int for 4 Months.

20. What is the Intereſt of *l.* 197 11 for 2 Months, at 6 *per Cent?* *Anſwer*, *l.* 1 19 $6\frac{9}{25}$.

21. What is the Intereſt of *l.* 491 17 10 for 5 Months, at 4 *per Cent?* *Anſwer*, *l.* 8 3 $11\frac{17}{30}$.

22. What is the Intereſt of *l.* 279 11 for $7\frac{1}{2}$ Months, at 4 *per Cent?* *Anſwer*, *l.* 6 19 $9\frac{3}{10}$.

23. What is the Intereſt of *l.* 571 15 for 8 Months, at 6 *per Cent. per Annum?*

		l.	*s.*		
	2|0)	571	15		
Mo.					
8	Co. $\frac{1}{5}$	28	11	9	Int. for 10 Months.
		5	14	$4\frac{1}{5}$	—— 2 —— Deduct.
		22	17	$4\frac{4}{5}$.	

24. How much is the Intereſt of *l.* 175 10 6 for 1 Year and 7 Months, at 6 *per Cent. per Annum?*

Anſwer, *l.* 16 13 $5\frac{3}{4}$ 19 Months $=10\times2-1=\frac{1}{10}$ of 10, or 20—1 *i. e.* $\frac{1}{10}-\frac{1}{20}$.

And thus may any other Sums at theſe Rates be performed, particularly 8, 9, 10, 11, 13 preceding.

Case III.

Interest for Days:

By the Principles assumed we have the following Analogy in Days.

Days: the given Time : : the Interest of the given Sum for 1 Year: to the Interest required. Alternately

Days: Interest of the given Sum for 1 Year : : given Time: Interest required.

25. What is the Interest of 100*l.* from the 7th of *May* to the 26th of *September*, at 8 *per Cent. per Annum?*

From 31 Days in the Month of May
Take 7

May	24
June	30
July	31
Aug.	31
Sep.	26

$365 \text{——} 8 \text{——} 142 \text{———} 3\ l.\ 2\ s.\ 2\frac{70}{73}\ d.$

26. At 6 *per Cent.* what will the Interest be of 100*l.* from the 5th of *July* to the 9th of *January?*

Answer, *l.* 3 1 $9\frac{51}{73}$.

27. How much is the Interest of 100*l.* from the 3d of *April* to the 25th of *February* following, at 7 *per Cent?*

Answer, *l.* 6 5 $9\frac{51}{73}$.

28. What is the Interest of 100*l.* from *June* 1st, 1767, to *March* 9th, 1768, which was Leap Year, at 5 *per Cent. per Annum?* *Answer*, *l.* 3 17 $6\frac{1}{4}\ \frac{231}{365}$.

Now if any Sum be given to find the Interest thereof for Days, it is manifest we must first find the Interest therof for a Year, *per* Ch. I. and then we may find the Interest for the given number of Days as in the foregoing Questions?

Examples.

29. How much is the Interest of 175*l.* for 1 Year and 73 Days, at 8 *per Cent. per Annum?*

l.	*l.*	*l.*	*l.*		
100 ——	8 ——	175 ——	14		
Days	*l.*	*Days*			
365 ——	14 ——	73		2	16
			l.	16	16

And ſince the Anſwer of the firſt Stating is the ſecond Number of the ſecond Stating, theſe Queſtions belong to the *Double Rule of Three Direct*, and may be ſolved by one double Stating, *viz.*

$$\begin{array}{rrcrl} & l. & & l. & \\ & 100 & & \cancel{175} & 35 \\ 73 & \cancel{365} & > 8 < & 438 & \textit{Anſwer, l.}\ 16\ \ 16. \end{array} \qquad \begin{array}{r} 365 \\ \underline{73} \\ 438 \end{array}$$

30. Caſt up 240*l.* for 1 Year and 135 Days, at 7 *per Cent. per Annum?* *Anſwer*, *l* 23 0 $3\frac{21}{73}$.

31. What is the Intereſt of 200*l.* from *Auguſt* 14, to *December* 19 following, at 6 *per Cent. per Annum?*
Anſwer. *l.* 4 3 $6\frac{6}{73}$.

32. What is the Intereſt of 371*l.* for 1 Year and 213 Days, at 6 *per Cent. per Ann?* *Anſw.* *l.* 35 5 $0\frac{36}{1825}$.

33. How much is the Intereſt of *l.* 150 15 6 for 53 Days, at 5 *per Cent. per Ann?* *Anſw* *l.* 1 1 $10\frac{2629}{36500}$.

34. A Merchant takes at Intereſt 250*l.* at 8 *per Cent.* for 2 Years, with Condition to pay before the Time as much of the Principal as he pleaſes: Now at the Expiration of 9 Months he pays 80*l.* and 6 Months after 70*l.* leaving the reſt the full Time of the aforeſaid two Years, I demand the Sum ſaid Merchant is then to pay?
Anſwer, 127*l.* 16*s.*

$$\begin{array}{rcll} 100 & & 250 & \quad l. \\ \cancel{4}\ \cancel{12} & > \cancel{8}\ 2 < & \cancel{9}\ 3 & \text{is } 15 \end{array} \qquad \text{1ſt -- } \frac{8 + 250 \times 9}{100 \times \cancel{12}}$$

$$\text{Or } \frac{\cancel{8} \times 250 \times 3}{100 \times \cancel{4}}$$

From 250
Take 80 the 1ſt Payment.

$$\frac{2 \times 250 \times 3}{100}$$

$$\begin{array}{rcll} 100 & & 170 & \quad l.\ \ \ s.\ \ d. \\ 2\ \cancel{12} & > 8 < & \cancel{6} & \text{——}6\ \ 16\ \ 2 \end{array} \qquad \frac{8 \times 170 \times 6}{100 \times \cancel{12}}$$

$$\begin{array}{llll} & \cancel{100} & \cancel{8} & \cancel{100} \\ 3 & \cancel{12} & 2 & 9 — 6 \end{array} \qquad \frac{\cancel{8}\times 170}{10\,0\times 2} \quad \frac{4\times 170}{100}$$

$$\frac{\cancel{8}\times\cancel{100}\times 9}{3d. -- \cancel{100}\times\cancel{12}}$$

Intereſt	27	16
Principal	100	
	l. 127	16

$$\frac{2\times 9}{3}$$

35. Suppoſe I take at Intereſt 300*l.* for 18 Months, at 6 *per Cent.* with Condition to pay as much of the Principal before the Time as I pleaſe. Now after 3 Months Time I pay 60*l.* and 4 Months after that 100*l.* and 5 Months after that I pay 75*l.* I want to know what I have yet to pay at the expiration of ſaid 18 Months?

Anſwer, 79*l.* 15*s.*

36. Given at Intereſt 600*l.* the 13th of *May* 1757, for 1 Year, at the Rate of 5 *per Cent. per Annum*, with Condition that the Receiver may Diſcharge as much of the Principal as he pleaſes before the Time. Now he pays the 9th of *July* 200*l.* and the 17th *Sep.* 150*l.* How much has he to pay for Principal and Intereſt at the Expiration of the Year? *Anſwer*, *l.* 266 13 $5\frac{7}{73}$.

---

† *Note.* The Pupil is recommended to work the Queſtions in the Following ſix Caſes, by *Decimals.*

Caſe IV.

When the Rate, Time, and Intereſt are given, to find the Principal.

Rule.

Divide the Intereſt by the Product of the Rate and Time, the Quotient is the Principal.

Examples.

37. I demand what Principal being put to Intereſt for 3 Years will gain *l.* 69 13 6, at 5 *per Cent. per Annum?*

Anſwer, *l.* 464 10 the Principal.

38. I demand what Principal being put to Intereſt for $5\frac{1}{2}$ Years will gain *l.* 64 7, at $4\frac{1}{2}$ *per Cent. per Annum?*

Anſwer, 260*l.*

39. I

39. I demand what Principal being put to Intereſt for 4 Years, at 4 *per Cent.* will gain *l.* 67 15 9¾?
Anſwer, 423*l.* 13*s.*

Caſe V.

When the Amount, Rate, and Time are given to find the Principal.

Rule.

Add 1 to the Product of the Rate, and Time, and by that Sum divide the Amount, the Quotient is the Principal.

Examples.

40. What Principal being put to Intereſt will Amount to *l.* 354 4 0½, in 7 Years at 3½ *per Cent. per Annum?*
Anſwer, *l.* 284 10 3½.

41. What Principal being put to Intereſt will Amount to *l.* 500 9 3¼ in 6 Years and 5 Months, at 5 *per Cent. per Annum?* *Anſwer*, *l.* 378 17 11½.

42. What Principal being put to Intereſt for 7 Years 220 Days, 4¼ *per Cent. per Annum* will Amount to *l.* 100?
Anſwer, *l.* 73 9 4.

Caſe VI.

When the Principal, Intereſt, and Rate are given to find the Time.

Rule.

Divide the Intereſt by the Product of the Principal and Rate, the Quotient is the Time.

Examples.

43. In what Time will *l.* 464 10 gain *l.* 69 13 6, at 5 *per Cent. per Annum?* *Anſwer*, 3 Years.

44. In what Time will *l.* 260 gain *l.* 64 7, at 4½ *per Cent. per Annum?* *Anſwer*, 5½ Years.

45. In what Time will *l.* 500 gain *l.* 130 9 7 at 6½ *per Cent. per Annum?* *Anſwer*, 4 Years, 5¼ Days.

Caſe

Case VII.

When the Principal, Amount, and Rate are given to find the Time.

Rule.

Take the difference between the Amount and Principal, and Divide it by the Product of the Principal and Rate, the Quotient is the Time.

Examples.

46. In what Time will *l.* 284 10 Amount to *l.* 354 4 0½, at 3¼ *per Cent. per Annum?*
Answer, 7 Years, 238$\frac{7}{18}$ Days.

47. In what Time will *l.* 672 5 Amount to *l.* 847 17 6, at 4¾ *per Cent. per Annum?* *Answer*, 5½ Years.

48. In what Time will *l.* 378 18 Amount to *l.* 500 9 3½, at 5 *per Cent. per Annum?*
Answ. 6,41467, or 6 Years, 5 Months (nearly.)

Case VIII.

When the Principal, Interest, and Time are given to find the Rate *per Cent.*

Rule.

Divide the Interest by the Product of the Principal and Time, the Quotient is the Rate.

Examples.

49. At what Rate *per Cent.* will *l.* 464 10 gain *l.* 69 13 6, in 3 Years? *Answer*, 5 *per Cent.*

50. At what Rate *per Cent.* will *l.* 260 gain *l.* 64 7, in 5½ Years? *Answer*, 4½ *per Cent.*

51. At what Rate *per Cent.* will *l.* 560 12 8½ gain *l.* 235 9 4, in 7 Years? *Answer*, 6 *per Cent.*

Case IX.

When the Principal, Amount, and Time, are given to find the Rate.

Rule.

Take the difference between the Amount, and Principal and divide it by the Product of the Principal and Time, the Quotient is the Rate.

Examples.

Examples.

52. At what Rate *per Cent.* will *l.* 284 10 Amount to *l.* 354 4 $0\frac{1}{2}$, in 7 Years? *Answer*, $3\frac{1}{2}$ *per Cent.*

53. At what Rate *per Cent.* will *l.* 378 18 Amount to *l.* 500 9 $3\frac{1}{4}$, in 6 Years?
Answer, *l.* 5 6 $11\frac{1}{4}$ *per Cent.*

54. At what Rate *per Cent.* will *l.* 672 5 Amount to *l.* 847 17 6, in $5\frac{1}{2}$ Years? *Answ.* $4\frac{3}{4}$ *per Cent.*

Case X.

The same being given to find the Amount.

Rule.

The Interest being found as before, add it to the Principal and that Sum is the Amount.

Example.

What will 1090*l.* amount to being forborn 17 Months, at 6 *per Cent. per Annum?*

l.	*s.*	
1090	00	
92	13	Interest found as before.
l. 1182	13	

Other-

Otherwife at one Operation by the following Proportion.

100 : 100 + the Rate : : Any Principal : the Amount, *viz.*

l.		Mo.
6 Int. of		12
$\frac{1}{3}$ 2		4
$\frac{1}{4}$ 0	10	1
8	10	17 Months.

100 —— $108\frac{1}{2}$ —— 1090
$108\frac{1}{2}$

8720
1090
545

1182|65 *Anfw.* 1182*l.* 13*s.*
20

13|00

This Cafe may likewife be folved by Decimals by making 1 and its proportionate Amount the firft and fecond Numbers, and then the Anfwer is obtained by Multiplication only, *viz.*

1 —— 1,085 —— 1090
1.085

545
872
109

1182.65

l. 1182 13

To prevent the Trouble of dividing by 365 in every Computation of Intereft for Days the following Tables have been calculated; the firft Term is the Intereft of 1*l.* for one Day at the given Rate; that is, .000136986 the firft Number of the Table of 5 *per Cent.* found thus.

100 > 5 < 1
365 > 5 < 1 *Anfw.* .000136986.

From which the other Numbers are made by *Addition.*

TABLES.

TABLES of *Simple Interest* for any Time at the sundry Rates following.

Days	4 *per Cent.*	$4\frac{1}{2}$ *per Cent.*	5 *per Cent.*	6 *per Cent.*
1	.0001095890	.0001232877	.0001369863	.0001643836
2	.0002191780	.0002465753	.0002739726	.0003287671
3	.0003287671	.0003698630	.0004109589	.0004931506
4	.0004383561	.0004931506	.0005479452	.0006575342
5	.0005479452	.0006164383	.0006849315	.0008219178
6	0006575342	.0007397259	.0008219178	.0009863013
7	.0007671232	.0008630136	.0009589041	.0011506849
8	.0008767123	.0009863012	.0010958904	.0013150684
9	.0009863013	.0011095899	.0012328767	.0014794520
10	.0010958904	.0012328767	.0013698630	.0016438356
20	.0021917808	.0024657534	.0027397260	.0032876712
30	.0032876712	.0036986301	.0041095890	.0049315068
40	.0043835616	.0049315068	.0054794520	.0065753424
50	.0054794520	.0061643835	.0068493150	.0082191781
60	.0065753424	.0073972602	.0082191780	.0098630136
70	.0076712328	.0086301369	.0095890410	.0115068492
80	.0087671232	.0098630136	0109589040	.0131506848
90	.0098630137	.0110958904	.0123287671	.0147945206
100	.0109589041	.0123287671	.0136986301	.0164383562
200	.0219178082	.0246575342	.0273972602	.0328767124
300	.0328767123	.0369863013	.0410958903	.0493150686
Months.		- - - - - -	- - - - - -	- - - - - -
3	.01	.01125	.0125	.015
6	.02	.0225	025	03
9	.03	.03375	.3375	.045
Years.		- - - - - -	- - - - - -	- - - - - -
1	.04	.045	.05	.06
2	.08	.090	.10	.12
3	.12	.135	.15	.18
4	.16	.180	.20	.24
5	.20	.225	.25	.30
6	.24	.270	.30	.36
7	.28	.315	.35	.42

Explication.

The first Column being Time, against it stands the Interest of 1*l* for that Time at the Rate specified on the Top of the Column; but the Interest of 1 Pound for any Time being given, the Interest of any Sum at the same Time may be found by *Multiplication*, *viz.* by multiplying the Interest of 1*l.*

1*l.* by the given Sum; and how to find the Intereſt of 1*l.* for any Time will eaſily appear by theſe

Examples.

1. Having the Intereſt of 1*l.* for any Days leſs than 10; To find the Intereſt thereof for 10 Times, 100 Times, &c. ſo many days.

Rule.

Remove the Decimal point one Place to the Right-hand for every Cypher in the Number of Days for which it is required to find the Intereſt of 1*l.*

Thus if the Intereſt of 1*l.* at 5 *per Cent.* for
3 Days is .00041095589, it will be for
30 ——— .0041095589, and for
300 ——— .041095589.

Problem II.

Having the Intereſt of 1*l.* for any Number of Days, To find the Intereſt of any given Sum for the ſame Time.

Rule.

Multiply the Intereſt of 1*l.* and the given Sum together, and the Product will be the Intereſt required.

Note, If the Number given be of Divers Denominations, the leſſer Denominations muſt be brought to the Decimal of a Pound.

Application.

What is the Intereſt of 100*l.* from the 7th of *May* to the 26th of *Sept.* at 6 *per Cent. per Annum.*?

Time found to be 146 Days.

Intereſt of 1*l.* for	100 Days	.01643836
——— ———	40 ——	.00657534
——— ———	6 ——	.00098630
	146 ——	.024
		.100
		2.4

Anſwer, *l.* 2 8

Example 2.

Unto what amounts the Intereſt of 79*l.* 15*s.* for 16 Years and 73 Days, at 5 *per Cent. per Annum*?

	l. Yr.		79 75
The Interest of 1 for 1 is—.05			.81
	10 is——.5		7975
	6 is——.3		63800
l. s. d.	70 D.——.009589041		
Answ. 64 11 11¼	3 ——.0004109589		*l.* 64 5975
	.8099999999		or 64 11 11¼

Thus may the Examples of Case 3d be done.

Annuities *and* Pensions *in Arrear.*

An *Annuity* or *Pension* is supposed payable upon the Day it becomes due; but if it be withheld or forborn, *i. e.* remain unpaid beyond the Day: it is said to be in *Arrears.*

Now if an Annuity payable Yearly be in Arrear, and it is required to know what the same will amount to, Simple Interest being Computed for every Particular Yearly Payment from the Time it became due until the Time it is paid, how to calculate this we shall shew in the following

Examples.

1. If an Annuity of 70*l.* be forborn 5 Years, what will be due for Principal and Interest at the End of said Term, Simple Interest being computed at 5 *per Cent. per Annum?*

Rule.

1. Find the Interest of the given Annuity for 1 Year. 2. And then for 2, 3, &c. Years up on to the given Time less 1. 3. Multiply the Annuity by the Number of Years given. 4. Add the several Interests and the said Product into one Sum.

The Operation.

1. 70	*l.*	Yr.	*l.* *s.*
5	Interest of 70 at 5 *per Cent.* for	1—	3 10
		2—	7 00
3|50		3—	10 10
20		4—	14 00
	5 Yrs. Annuity at 70*l.* *viz.*	70×5—	350 00
10|00			
		Answ.	*l.* 385 00

By *Decimals*.

70	1 Yr.—	3.5
.05	2 ——	7.
——	3 ——	10.5
3.50	4 ——	14.
		350
		l. 385

2. If the Payment of a Pension be omitted for 7 Years, what will it amount to in that Time at 6 *per Cent*. supposing it 56*l*. *per Annum?* *Answ*. *l*. 462 11 $2\frac{2}{7}$.

3. A House being let upon a Lease of 7 Years, at 50*l*. *per Annum* and the Rent being in Arrear for the whole Term, I demand the Sum due at the End of the Term, Simple Interest being allowed at 4 *per Cent. per Annum?* *Answ*. 392*l*.

4. Suppose a Salary of 100*l*. *per Annum* be forborn 7 Years, what is the Amount at $4\frac{1}{2}$ *per Cent per Annum?* *Answ*. 794*l*. 10*s*.

5. If an Annuity or Yearly Rent of *l* 134 10 6 be all forborn till the End of 4 Years what will it then Amount to, Simple Interest being allowed at the Rate of 6 *per Cent. per Annum?* *Answ*. *l*. 586 10 $6\frac{96}{100}$.

But if Simple Interest were allowed upon Half-yearly or Quarerly Payments, it would be still more in Favour of the Receiver.

Find the Interest of the last Payment but one, and then of the others as before, *viz*

6. If 70*l*. Annuity, payable every half Year, were unpaid 5 Years, what will it amount to in that Time at 5 *per Cent.?*

Last Payment but one, Half-a-Year's Annuity 35*l*.

	Yr.		*l*.	*s*.	*d*.		
35							
.025	$\frac{1}{2}$	——	0	17	6	Or	.875
——	1	——	1	15	0	——	1.750
175	$1\frac{1}{2}$	——	2	12	6	——	2.625
70	2	——	3	10	0	——	3.500
——	$2\frac{1}{2}$	——	4	07	6	——	4.375
.875	3	——	5	05	0	——	5.250
——	$3\frac{1}{2}$	——	6	02	6	——	6.125
17 6	4	——	7	00	0	——	7.000
	$4\frac{1}{2}$	——	7	17	6	——	7.875
Principal 35 × 10		==	350	00	0	——	350
	L 2		*l*. 389	07	6		389.375

CHAP. VI.

REBATE OR DISCOUNT.

REBATE or Difcount is an Allowance made upon any Sum of Money being paid before it becomes due; or upon advancing ready Money for Bills, Notes, *&c.* which are payable at a future Day. And this Allowance is fometimes computed at fo much *per* Pound *Sterling*, and fometimes at fo much *per Cent. per Annum* Simple Intereft.

1. *Difcount computed* per *Pound Sterling.*

Difcount at fo much *per* Pound Sterl. may be computed by Aliquot Parts, *viz.* dividing the given Sum to be difcounted by the Denominator of that Part which the Difcount of 1*l.* is of 1*l.* The Quotient is the Difcount, which being fubtracted from the given Sum, the Remainder is the Sum to be advanced in ready Money.

Examples.

1. Bought Goods of *A. B.* amounting to *l.* 127 13 4 and for Prompt Payment am allowed 6*d.* in the Pound; I want to know how much I muft pay him?

	l.	*s.*	*d.*		Decimally.
d. *l.*	127	13	4		127.6
6 of 1 is $\frac{1}{4}\vert_0$	3	3	10	Difcount.	.025=6*d.*
Anfw.	*l.* 124	9	6		6380
					2552
					3.190
					l. 3 3 10, *&c.*

2. Changed *Nathan Needy, Richard Drawer's* Bill on *Peter Paywell* of *Corke*, at 31 Days Sight for 154*l.* at 2*d. per l.* Difcount, how much ready Money muft I pay for faid Bill?

Anfw. *l.* 152 14 4.

3. How much ready Money muft I advance for 572*l.* 17*s.* 8*d.* Difcount being allowed, at 4*d. per l.*

Anfw. *l.* 563 6 8$\frac{1}{2}$.

4. Bought 6 Pipes of Wine each 121 Gallons, at 4*s.* 9*d. per* Gallon by Auction, and for prompt Payment am allowed 1*s. per* Pound Difcount, what muft I pay for faid Wine?

Anfw. *l.* 163 16 0$\frac{9}{10}$.

2. *Difcount computed at a given Rate* per Cent. per Ann.

If 106 : 100 : : given Sum : its prefent Worth or Payment, it fhall be 106 :(106— 107)6 : : Any Sum to be rebated to the fame Sum lefs its prefent Worth, *i. e.* to the rebate.

Note, The Rebate subtracted from the Sum discounted leaves the present Worth, *et contra.*

Examples.

5. A Merchant buys certain Merchandizes to the Value of 648*l*. payable in 12 Months; how much ready Money must he pay Rebate at 8 *per Cent. per Annum?*

```
 100
   8
 ----          l.
 108----100----648
               100   l.
          108) 64800 (600 Answer.
               648
```

To prove the WORK.

Find the Amount of the present Payment at the Time and Rate given, and that will be equal to the given Sum to be rebated. 100——108——600

```
                 600
               ------
               648|00
```

6. If a Debt of a 100*l*. 6*s*. be payable at the End of a Year to come, how much ready Money will discharge the Debt at the Rate of 6 *per Cent per Annum?*

Answ. *l*. 94 12 $5\frac{1}{5}\frac{3}{5}$.

7. What is the Rebate of *l*. 45 15 6 for 12 Months, at 6 *per Cent. per Annum?* *Answ.* *l*. 2 11 $9\frac{4}{5}\frac{5}{5}$.

8. I demand how much ready Money I must pay for 432*l*. 14*s*. for 12 Months, Rebate at 7 *per Cent. per Annum?*

Answ. *l*. 404 7 $10\frac{22}{107}$.

When any other Time beside a Year is given, find the Interest of 100 for that Time at the given Rate, which must be added to 100 for the first Number, as in the following

Examples.

9. What is the Rebate of *l*. 795 11 2 for 11 Months, at 6 *per Cent. per Annum?*

```
12—6—11            Or thus,              Or thus
   11                     6                    6
12)66            6 Mo is 1/2  3      11 Mo. Co. 1/12 0 10
------           4 —— 1/3     2               ------
l.5  6           1 —— 1/4     0 10         l. 5   10
    20                 ----------
------                 l. 5   10 Interest of 100 for
12)120                                11 Months.
l. 10
```


Then 105

Then 105 10——5 10——795 11 2

20 20 20

2110 110 15911

12 12

25320 190934

110

2|0)

2532|0)210027|4|0(82|9 5

20256 41 9 $5\frac{2292}{2532}$

7467

5064

24034

22788

1246

12

14592

12660

2292

By Decimals.

105.5 5.5 795.5583

5.5

39777916

39777916

105.5)4375.570766(41.4746

42200 *l.* 41 9 $5\frac{3}{4}$

1555

1055

5007

4220

7870

7385

4857

4220

6376

6333

l.	*s.*	*d.*	
795	11	2	
41	9	6	Rebate,
l. 754	1	8	to pay down.

10. What ready Money must I pay for *l.* 161 10 due in 19 Months, Discount being allowed at 5 *per Cent. per Annum?* *Answ* *l.* 149 13 $0\frac{1}{2}$.

11. Bought Goods amounting to *l.* 795 11 2, at 4 Months Credit, how much ready Money must I pay, Discount at $3\frac{1}{2}$ *per Cent. per Annum?* *Answ.* *l.* 786 7 $8\frac{1}{4}$.

12. What is the present Worth of 4000*l.* payable in 9 Months, at $4\frac{3}{4}$ *per Cent. per Annum?*

Answer, *l.* 3862 8 $0\frac{1}{2}$.

13. Tell me the Rebate of *l.* 112 12 for 20 Months, at 7 *per Cent. per Annum?* *Answ.* *l.* 11 15 $3\frac{27}{87}$.

14. Some Merchandizes being bought for 5150*l.* with $4\frac{1}{2}$ Months Discount, at 8 *per Cent. per Annum*; besides 1 *per Cent.* for prompt Payment. How much ready Money must I pay? *Answer*, 4950*l.*

III.

When sundry Sums are to be paid at Different Times, find the Rebate or present Worth of each particular Payment separately, and when so found add them into one Sum.

Examples.

15. *A.* is indebted to *B* 432*l.* payable in 12 Months. More 580*l.* payable in 2 Years; now if *A* has a mind to pay both these Sums immediately, Rebate being allowed at 8 *per Cent per Annum* how much must he pay?

In 1 Year *l.* *l.* *l.*
108 ——— 100 ——— 432 comes 400
In 2 Years
116 ——— 100 ——— 580 ——— 500
Answ. *l.* 900

16. What is the Rebate of 756*l.* the one Half payable in 6 Months, and the other Half payable in 6 Months after that, at 7 *per Cent. per Annum?* *Answ.* *l.* 37 10 $2\frac{1218}{2461}$.

17. I have *A B*'s Notes, *viz.* one for 20*l.* payable in 3 Months, and another for 36*l.* payable in 9 Months, and having occasion to raise Money upon them; I get them discounted at 6 *per Cent. per Annum*; what Money must I receive? *Answ.* *l.* 54 3 $1\frac{281}{2227}$.

18. Discounted the following Notes at 5 *per Cent. per Annum*:

	l.	*s.*	
J D's to myself	150	10	payable 37 Days hence,
A B's to *E L*	27	15	payable 15 Days
B C to *T P*	18	00	payable in 15 Months.

I want to know how much Money I must receive?

Answ. *l.* 194 7 $6\frac{1}{2}$

19. What is the present Worth of 200*l* at 4 *per Cent. per Annum.* payable, *viz.* 100*l.* at 2 Months. 50*l.* at 3 Months, and 50*l.* at 5 Months? *Answer*, *l.* 198 0 $5\frac{1}{2}$.

20. What ready Money must I pay for 1000*l.* of which 300*l.* is payable in 1 Year; 300*l.* payable in 2 Years; and the rest in 3 Years, discounting 8 *per Cent. per Annum?*

Answer, *l* 858 $\frac{23766}{24273}$.

In like Manner we find the present Worth of an Annuity, rebating at simple Interest for any assigned Number of Years; for suppose it required to find the present Worth of an Annuity of 100*l.* it is manifest we must compute the present Worth of 100*l.* due at the first Year, also the present Worth of 100*l.* due at the End of the second Year, and so on, re-

peating the Operation for every Year of the Term, and it is plain the Sum of all these present Worths of each Year's Rent, will be the present Worth of the Annuity for the Term of Years assigned.

Examples.

21. How much present Money is equivalent to an Annuity of 100*l.* to continue 5 Years; Rebate being made at 6 *per Cent. per Annum?*

106 : 100 : : 100 94.33962 pres. Worth of 1 Year's An.
112 : 100 : : 100 : 89.28571 ———— 2 ————
118 : 100 : : 100 : 84.74576 ———— 3 ————
124 : 100 : : 100 : 80.64516 ———— 4 ————
130 : 100 : : 100 : 76.92307 ———— 5 ————

Answer, l. 425.93932 or 425 18 $9\frac{1}{2}$.

22. What is the present Worth of an Annuity of 50*l.* to continue 6 Years, at 5 *per Cent. per Annum*, simple Interest? *Answer, l* 256 13 7.

23. What is 80*l.* yearly Rent to continue 5 Years, worth in ready Money, at 6 *per Cent?* *Answer, l.* 340 15 $0\frac{1}{4}$.

24. What is a Salary of 40*l. per Annum*, to continue 7 Years, worth in ready Money, at 4 *per Cent?*
Answer, l. 242 10 9.

25. What is a Pension of 30*l. per Annum*, for 5 Years, worth in ready Money, at $4\frac{1}{2}$ *per Cent?*
Answer, l. 132 11 $5\frac{1}{2}$.

IV.

26. A Merchant is indebted 2163*l.* 3*s.* payable at 12 Months; but pays it at the Expiration of 5, discounting at the Rate of 6 *per Cent. per Annum*, how much should he pay? *Answ.* 2090*l.*

From 12 Months Time given,
Take 5 ———— when Payment was made,
Rem. 7 ———— to be discounted for,

	l		*Mo.*	
	6 Rebate for		12	
6 is $\frac{1}{2}$	3	——	6	
1 - $\frac{1}{6}$	0 10	——	1	
	3 10	——	7	
	100			
	103 10	——	100	—— 2163 3

Answer, 2090*l.*

27. If the aforesaid sum was paid in 3 Months, how much ought he to pay? *Answer*, 2070*l.*

28. Suppose a Bill drawn the 25th *September*, 1792, payable* 3 Months after Date, for 540*l.* 15*s.*, was discounted on the 18th of *October* following, at 6 *per Cent per Annum*, what Sum was received for it?

Answer l. 534 10 $3\frac{219}{407}$.

29. A Merchant owes 110*l.* payable in 20 Months, and 224*l.* payable in 24 Months: the first he pays in 5 Months, and the other 1 Month after, Discount at 8 *per Cent. per An.* I demand the Sum he paid? *Answer*, 300*l.*

30. *Dublin*, the 27th *Sept.* 1796. discounted for *Leonard Lackash*, *Chr. Kiteflyer*'s Promissory Note at 2 Months, for 20*l.* dated the 1st Inst *Edward Empty*'s ditto, dated 17th ditto at 3 Months for 37*l.* 10*s.* and *Thomas Trusty*'s Bill on *Peter Paywell*, for 50*l.* at 31 Days Sight, accepted by said *Paywell*, the 20th Instant, Discount 6 *per Cent. per Annum*; what must I pay him for said Notes and Bill? *Ans. l.* 106 13.

Note. Altho' the foregoing Method is the true and proper Way of casting up Discount; yet the usual Method in Practice is to calculate the Interest that would be due upon the Sum discounted in the Time, which the Bill, Note, or Debt hath to run; and deducting the said Interest from the Sum discounted, to pay the rest as full consideration for the Sum discounted; this Method is readier and easier than the true Method before laid down, and in small Sums for a short Time the Difference is inconsiderable; but the Difference becomes very considerable, if a large Sum be to be discounted; or if the Time be long for which the Discount is to be allowed.

Find the different Sums to be paid for 100*l.* by both Methods for 1 Month, 1 Year, and 10 Years, Discount being allowed at 6 *per Cent. per Annum*?

	True Method,				Common Method,		
	l	*s.*	*d*		*l.*	*s.*	
Answ.	99	10	$0\frac{120}{201}$	——	99	10	for 1 Month,
	94	6	$9\frac{54}{106}$	——	94	0	for 1 Year,
	62	10	0	——	60	0	for 10 Years,

* *Note* Three Days are allowed beyond the Day of Date when a Bill or Note becomes payable, which are called *Days of Grace*; so these three Days must be added as this Bill becomes due according to Date 25th *Dec.* but according to Custom on the 28th

From the above it appears that the Difference is less than $\frac{3}{4}d.$ for 100*l.* for 1 Month; but becomes more considerable as the Time is longer; for by the common Method the Sum to be paid is 6*s.* $9\frac{1}{2}d.$ too little for a Year, and 2*l.* 10*s.* in 10 Years.

However as the last Method is that most generally used in Business, it may be proper that the learner be set to work some of the preceding Questions thereby.

Equation of Payments

† Is when several Debts are payable at different Times, but is mutually agreed between Debtor and Creditor, that all those several Sums be paid at once, and at such a Time as that neither Party may be wronged thereby; this is called Equating the Time of Payment, for which this is the

Rule.

Multiply the Sum of each particular Payment by its Time, then add the Products together, and divide the Sum by the whole Debt, the Quotient (by this Rule) is the Equated Time for the Payment of the whole.

Examples.

1. *B*, owes *C*, 600*l.* whereof 200*l.* is to be paid at 3 Months, 150*l.* at 4 Months, and the rest at 6 Months; but they afterwards agreed the whole should be paid at once; required the Time? *Answer*, 4 *Months*, 15 *Days.*

2. *A*, bought of *B*, a Quantity of Goods which came to 460*l.* to be paid in the following manner, *viz.* 260*l.* at 5 Months, and the rest at 7 Months, but afterwards they agree to make one Payment of the whole; I demand the Equated Time? *Answer*, 5 *Months*, $26\frac{2}{23}$ *Days.*

3. *C*, owes *D*, a certain Sum which is to be discharged in the following Manner, *viz.* $\frac{1}{2}$ at 3 Months, $\frac{1}{3}$ at 4 Months, and $\frac{1}{6}$ at 9 Months, but they afterwards agree to have but one Payment of the whole; the Equated Time is required? *Answer*, 4 *Mo.* 10 *Days.*

4. A Debt is to be discharged thus, *viz.* $\frac{1}{4}$ at present, $\frac{1}{4}$ at 4 Months, and $\frac{1}{4}$ at 5 Months, and the rest at 6 Months; What is the Equated Time for the whole? *Answ.* 5 *Mo.*

5. *E*, is indebted to *F*, 240*l.* which by agreement is to be paid at 5 Months hence, but *E*, is willing to pay 40*l.* down, provided he will give him a longer Time for the Payment of the Remainder, which is agreed on, the Time of Payment is required? *Answer*, 6 *Months*.

CHAP. VII.

EXCHANGE.

THE Doctrine of *Exchange*, taken in its full Extent, would far exceed the Bounds of a Chapter in such a Treatise as this; but as far as it is usually considered as a Rule of Arithmetick, it is chiefly comprehended in this Problem, *How to reduce the Money of one Country into that of another, according to any given Rate or Proportion.*

In most Countries they have real and imaginary Monies, the real Monies are the Coins made, or current, in the Country. The imaginary are those whereby they keep their Accounts and calculate their Payments.

Par, in Exchange, is a supposed Equality between the Monies of one Country and those of another, *i. e.* when the Money received for a Bill* of Exchange is equal in Value to the Money paid for it, then Exchange is said to be at Par.

The Course of Exchange is the Value which the Coin of one Country (taken for the Standard of Exchange) will yield in another.

So the Par is fixed, being the supposed real Value of foreign Money in any country; but the Course of Exchange is variable and fluctuating, being sometime above and sometime below Par: For Bills of Exchange are a Kind of commodity, which rise and fall in Price according as there is a greater or less Demand for them.

SECT. I.

Of Exchange *between* Dublin *and* London.

Dublin and other Places of *Ireland*, exchange immediately with *London* only; and draw their foreign, as well as *English* Demands by that Channel, so we shall shew first how to reduce *English* Money into *Irish*, and *contra*; and then how to reduce foreign Money into *English*, and the Contrary.

* *A Bill of Exchange* is a written Order delivered in one Place for Value received there, for the like Value, according to a Rate of Exchange agreed upon, to be paid in the Place on which the Bill is drawn.

The Exchange between *Ireland* and *England* is calculated at a certain Rate *per Cent.* viz. *Ireland* gives 100*l.* × the Rate of Exchange for 100*l.* *English*.

In both Kingdoms Accounts are kept in Pounds, Shillings and Pence: the Coins or real Monies of *England* are Guineas, Half-Guineas, Crowns, Shillings, &c. all which are current in *Ireland*, viz.

An *English* Shilling is current in *Ireland* at 1*s.* 1*d.* and the other *English* Coins in the same Proportion, according to which Proportion 100 *English* are equal to $108\frac{1}{3}$ *Irish*; So that the Par of Exchange between *England* and *Ireland* is $8\frac{1}{3}$ *per Cent.*

The Course of Exchange is generally from 5 to 12 *per Cent.*

I. *To reduce* English *Money to* Irish *at Par.*

Rule.

To the *English* Money add $\frac{1}{12}$ thereof, the sum is the *Irish* Money equal thereto.

50*l.* *English*, how much in *Irish* Currency?

50 0 0				
$\frac{1}{12}$ 4 3 4	*Reason.*	1 *Eng.*	=	$1\frac{1}{12}$ *Irish.*
	Therefore	50 *Eng.*	=	$50 \times \frac{13}{12}$
l. 54 3 4				

2. How much in *Irish* Currency will *l.* 15 17 6 amount to? *Answer*, *l.* 17 3 $11\frac{1}{2}$.

3. Suppose I have a Legacy of 150*l.* left me in *England*, and have it transmitted in Specie, how much *Irish* Currency am I to receive? *Answer*, *l.* 162 10 0.

4. Sent by *Daniel Draper* to sell for me at *Chester* Fair, 50 Dozen of Silk Handkerchiefs, which he sold at 4*s.* 8*d.* *per* Piece; now admit I allow him $2\frac{1}{2}$ *per Cent.* Commission, what Sum *Irish* am I to receive?
Answer, *l.* 147 17 6.

II. *To reduce* Irish *Money into* English *at Par.*

Rule.

From the *Irish* Money subtract $\frac{1}{13}$ thereof, the Remainder is *English*.

5. In *l.* 54 3 4 *Irish* Money how much *English?*

	l. 54	3	4
$\frac{1}{13}$	4	3	4
Answ.	*l.* 50	0	0

6. How much *English* Money will *l.* 17 05 $11\frac{1}{2}$ *Irish* amount to? *Answer,* *l.* 15 17 6.

7. I sent to my Correspondent, at *Liverpool* in Specie, *l.* 162 10 *Irish*, how much must he give me credit for on this Account? *Answer,* 150*l.*

To reduce English *Money to* Irish, *at any given Rate of Exchange.*

1. The Exchange is found in all Cases by Chap. IV. of this.

2. Add the Exchange to the *English* Money, the Sum is *Irish.*

Examples.

8. A Merchant in *Dublin*, draws on his Correspondent at *London*, for 120*l* and passes his Bill at 5 *per Cent.* how much money is he to receive? *Answ.* 126*l.*

1st Method,

	l.	
120	120 *Eng.*	
5	6	Exch.
6|00	126	*Irish.*

2d Method by Aliquot Parts,

	l.
	120
$5\ \frac{1}{20}$	6
	126

3d by Decimals.

120
.05
6.00

9. *l.* 270 *English*, at 7 *per Cent.* how much *Irish?* *Answer,* *l.* 288 18,

10. *l.* 510 *English*, at 8 *per Cent.* what will it come to? *Answer,* *l.* 550 16.

11. *l.* 955, at 6 *per Cent.* what will it come to? *Answer,* *l.* 1012 6*s.*

12. *l.* 750 18 8, at 7 *per Cent.* how much is it?

l.		
750	18	8
		7
52|56	10	8
20		
11|30		
12		
3|68|17		
100|25		

l.	*s.*	*d.*	
750	18	8	—*Eng.*
52	11	$3\frac{17}{25}$	Exch.
803	9	$11\frac{17}{25}$	

2d Method

	l.	*s.*	*d.*	
	750	18	8	
$5\ \frac{1}{20}$	37	10	11	$\frac{1}{5}$
$2\ \frac{1}{50}$	15	0	$4\frac{12}{25}$	
	l. 52	11	$3\frac{17}{25}$	Exch.

3d Method.

750.933			
.07			
52.56531			
52	11	$3\frac{3}{4}$	Exch.

	l.	*s.*	*d.*				*l.*	*s.*	*d.*
13.	901	1	11	at 8 *per Cent.*		*Answ.*	973	3	$8\frac{1}{25}$.
14.	300	15	6	at 9	———	———	327	16	$10\frac{37}{50}$.
15.	199	19	11	at 11	———	———	221	19	$10\frac{89}{100}$.
16.	999	19	9	at 3	———	———	1029	19	$8\frac{91}{100}$.

17. *l.* 309 15 4 *English*, at $4\frac{1}{4}$ *per Cent.* Advance, how much is it *Irish*? *Answer*, *l.* 322 18 $7\frac{31}{50}$.

l. *s.* *d.*
309 15 4
$4\frac{1}{4}$
———
1239 1 4
77 8 10
———
13|16 10 2
20
———
3|30
12
———
3|62 | 31
——— | ———
100 50

l. *s.* *d.*
309 15 4
13 3 $3\frac{31}{50}$
———
322 18 $7\frac{31}{50}$
———

2d Method,
5) 309 15 4
———
$4 - \frac{1}{25}$ 5) 61 19 $0\frac{4}{5}$
———
$\frac{1}{4} - - \frac{1}{16}$) 12 7 $9\frac{19}{25}$
0 15 $5\frac{43}{56}$
———
13 3 $3\frac{31}{50}$

3d Method,
309.766
.0425
———
1547830
619532
1239064
———
13.1649550
———
13 3 $3\frac{1}{2}$

Or shorter thus,
309.766
$.04\frac{1}{4}$
———
12 39064
$\frac{1}{4}$ - - 77441
———
13 16505

	l.	*s.*	*d.*				*l.*	*s.*	*d*
18.	709	0	0	at $7\frac{3}{4}$ *per Cent.*		*Answ.*	763	18	$11\frac{2}{5}$
19.	250	0	0	at $3\frac{7}{8}$	——	——	259	13	9
20.	103	0	11	at $5\frac{1}{3}$	——	——	108	10	$9\frac{296}{300}$
21.	300	15	0	at $7\frac{1}{2}$	——	——	323	6	$1\frac{1}{2}$
22.	460	19	9	at $5\frac{3}{4}$	——	——	487	9	$10\frac{251}{400}$
23.	999	19	0	at $3\frac{7}{8}$	——	——	1038	13	$11\frac{107}{200}$
24.	150	18	$6\frac{3}{4}$	at $5\frac{1}{2}$	——	——	159	4	$7\frac{1}{800}$
25.	380	15	$9\frac{1}{2}$	at $5\frac{3}{4}$	——	——	402	13	$8\frac{317}{800}$
26.	400	0	$6\frac{1}{4}$	at $7\frac{1}{8}$	——	——	428	10	$6\frac{69}{128}$
27.	519	19	$11\frac{3}{4}$	at $6\frac{3}{4}$	——	——	555	1	$11\frac{1173}{1600}$
28.	100	10	$6\frac{1}{4}$	at $5\frac{1}{8}$	——	——	105	13	$6\frac{461}{640}$

To reduce Irish *Money into* English.

29. A Merchant in London has a Bill of Exchange for 100*l.* *Irish* Money, which he sells or negociates at 5 *per Cent.* that is, 105*l.* in *Ireland* is worth 100*l.* in *England.* I demand how much *English* Money he is to receive?

Irish *English* *Irish*
105 ——— 100 ——— 100 *Answ.* *l.* 95 4 $9\frac{1}{2}$.

	l.	*s.*	*d.*					*l.*	*s.*	*d.*
30.	160	10	0	at	7	*per Cent?*	*Anſ.*	150	0	0
31.	545	14	0	at	7	——	—	510	0	0
32.	1093	13	3	at	$7\frac{3}{4}$	——	—	1015	0	0
33.	323	6	$1\frac{1}{2}$	at	$7\frac{1}{2}$	——	—	300	15	0
34.	62	2	0	at	$3\frac{1}{2}$	——	—	60	0	0
35.	100	0	0	at	$5\frac{1}{8}$	——	—	95	2	$5\frac{811}{841}$
36.	314	5	0	at	$4\frac{3}{4}$	——	—	300	0	0
37.	259	13	9	at	$3\frac{7}{8}$	——	—	250	0	0

Sect. II.

Of Exchange between England, Holland *and* Flanders.

England exchanges with *Holland* and *Flanders* at ſo many Schellings and Groot or Deniers Flemiſh *per* Pound Sterling.

Books of Accounts are kept in *Holland* ſometimes in Pounds, Schellings, and Groot Flemiſh; but more frequently in Guilders, Stivers and Pennings.

The Par of Exchange between *England* and *Holland* is about 36.59*s.* *per* Pound Sterling, and between *London* and *Antwerp*, 35*l.* 17*s.*

8 Pennings	make	1 Groot		2 Groots	make	1 Stiver.
12 Groot	make	1 Schel.		6 Stivers	make	1 Schell.
20 Schellings	make	1 Pound		20 Stivers	make	1 Guild.
				6 Guild.	make	1 Pound.

To reduce Engliſh *Money into* Flemiſh *Pounds.*

38. Reduce 482*l.* 18*s.* Sterling, into Flemiſh Pounds, Exchange at 35*s.* 10*d.*

		l.	*s.*			
l. *s.*		482	18	at 1 15 10		☞ For 33*s.* 4*d.* multiply
of 1 - 10	$\frac{1}{2}$	241	9			the Sterling Money by 5
of 10*s.* 5	$\frac{1}{2}$	120	14	6		and divide the Prod. by 3.
of 5--10*d.*	$\frac{1}{6}$	20	2	5		For 400 (Pence in 33*s.* 4*d.*)
		———	———			: 240 (P. in 20*s.*) : : 5 : 3
		l. 865	3	11	*Anſw.*	& *contra* 240 : 400 : : 3 : 5.

39. A Merchant in *Antwerp* hath a Bill of Exchange for 100*l.* payable in *London*, which he negociates at 33*s.* 4*d.* Flemiſh *per* Pound Sterling; how much Flemiſh Money muſt he receive? *Anſwer*, *l.* 166 13 4.

d. Sterl.

8) 24|0 : : 40|0 : : 100 : : $166\frac{2}{3}$ or 13*s.* 4*d.*

3 5

40. A Merchant in *Rotterdam* hath a Bill drawn on him for *l.* 673 16 8 Sterl. Exchange at 33*s.* 4*d.* Flemish *per* Pound Sterling; how much must he pay there?

Answer, *l.* 1123 1 $1\frac{1}{3}$.

41. One in *Antwerp* delivering Money by Exchange for *London*, at 35*s.* 6*d.* *Flem.* *per* Pound Sterling; how much must he pay there to receive here 597*l.* Sterling?

Answer, *l.* 1059 13 6 *Flem*

42. How many Pounds *Flem.* are in *l.* 169 10 11 Ster. at 33*s.* 3*d.* *per* Pound Sterl? *Answ.* *l.* 281 17 $4\frac{63}{80}$.

To reduce Flemish *Money into* Sterling?

43. Reduce *l.* 865 3 11 *Flem.* into Sterl. at 35*s.* 10*d.* *Flem.* *per* Pound Sterling?

s.	*d.*	*l. Sterl.*	*l. Fl.*	*s.*	*d.*
35	10	1	865	3	11
12			20		
430			17303		
			12		

l. *s.*

43|0) 20764|7 (482 18 *Answ.*
172

356
344

124
86

387
20

774|0
43

344
344

44. If 1*l.* Sterling is 33*s.* 4*d.* *Flemish*, how much Sterling is equal to *l.* 166 13 4 *Flemish*? *Answer*, 100*l.*

45. How much Sterling is equal to *l.* 1123 1 $1\frac{1}{4}$ *Flem.* at 33*s.* 4*d.* *per* Pound Sterling? *Answ.* *l.* 673 16 8.

46. How much *English* Money is *l.* 1059 13 6 *Flem.* Exchange 35*s.* 6*d.* *Flem.* *per* Pound Sterl.? *Answ.* 597*l.*

To reduce Sterling *Money into* Guilders.

47. How many Guilders Bank are equal to *l.* 852 12 6 Sterling, Exchange at 34*s.* 4½*d.* *per* Pound Sterling?

1st Method by the Rule of Three.

l. Sterl.	*s.*	*d.*	*l.*	*s.*	*d.*
1 ———	34	4½ ———	852	12	6 = ⅝
	12		825		

412
2
———
825
852⅝
———
1650 *Answ.* 8792 Guild. 13 St. 14½ Pen.
4125
6600
⅘ ½ ··········· 412½
⅛ ¼ ··········· 103⅛
———
8|0) 70341|5 ⅝ Half-pence or half-Groot
———
8792 4) 55⅝ Half-Groot
———
13 29/32 = 13 Stiv. 29 Half-Pen.
i. e. 14½ Penning.

2d Method. Reduce the Pound Sterling to Pound *Flemish*, and then the *Flemish* Pounds and Shillings into Guilders and Stivers, by multiplying by 6.

s.	*d.*		*l.*	*s.*	*d.*		*s.*	*d.*
			852	12	6	at	31	4½
10	0	···· ½	426	6	3			
4	0	···· ⅕	170	10	6			
0	4	·· 1/12	14	4	2½			
½		·· ⅛	1	15	6 5/16			
			1465	8	11 1/12			
					3 11/16			
			1465	8	15¾			
					6			
			8792	13	14½			

To reduce Flemish Pounds, Shillings and Pence to Guilders, Stivers and Pennings, add $\frac{1}{3}$ of the Pence to the Number of Pence, and then multiply the Pounds, Shillings and Pence so encreased $\frac{1}{3}$ by 6.

Method 3. Reduce the Rate of Exchange into Guilders, Stivers and Pennings, then multiply the Sum *English* by the Guilders, and for the Stivers and Pennings take the Parts of a Guilder, *&c.* The English Money is *l. s. d.* which are something different from the form of *Guil. Stiv.* and *Pen.* Yet I may put them into the Form thereof by adding $\frac{1}{3}$ to the Pence of the given Sum, and multiplying and dividing the Denominations as Guilders, Stivers and Pennings; but as we are more used to the Form of *l. s. d.* we may multiply and divide them in that Form, and by adding $\frac{1}{3}$ of the resulting Pence to themselves, we reduce them to Pennings.

	l.	*s.*	*d.*		*l.*	*s.*	*d.*	
	852	12	6	Sterl. at	1	14	$4\frac{1}{2}$	*Flem.*
			10				6	Guilders 1*l.*
Sti. P.	8526	5	0		10	6	3	
5 — $\frac{1}{4}$	213	3	$1\frac{1}{2}$					
1 — $\frac{1}{5}$	42	12	$7\frac{1}{2}$					
0 3 — $\frac{1}{4}$	10	13	$1\frac{7}{8}$					
	8792	13	$10\frac{7}{8}$					
			$3\frac{1}{8}$	$=\frac{1}{3}$ of $10\frac{7}{8}$ add				
Answ.	8792	13	$14\frac{1}{2}$					

48. How many Guilders are in 1409*l.* Sterl. if 1*l.* Sterl. is 33*s.* 8*d.* Flemish? *Answer*, 14230 Guil. 18 Stiv.

49 In *l.* 100 10*s.* Sterl. at 33*s.* 9*d.* Flem. *per l* Sterl. how many Guilders is it? *Answer*, 1017 Guil. $11\frac{1}{4}$ Stiv.

50. Tell me how many Guilders are in *l.* 1941 15 6 Sterl. the Exchange at 33*s.* 11*d.* Flem. *per l* Sterling?
Answer, 19757 Guilders, 11 Stivers, $3\frac{96}{270}$ Pennings.

51. At 34*s.* 5*d.* Flem. *per l.* Sterl. I would know how many Guilders there are in *l.* 1597 9 11 Sterling?
Answer, 16494 Guilders, 2 Stivers, $14\frac{56}{240}$ Pennings.

To reduce Guilders into Sterling Money.

52. If the Exchange between *London* and *Amsterdam* be 34*s.* $4\frac{1}{2}$*d.* *Flem.* per *l.* Sterling, how much *English* Money will be equal to 8792 Guilders, 13 Stivers, $14\frac{1}{2}$ Pennings?

s.	*d.*		*l.* Sterl.	*G.*	*St.*	*Pen.*
34	$4\frac{1}{2}$	——	1 ——	8792	13	$14\frac{1}{2}$
12				20		
412	Groot			175853	Stivers	
8				16		
3300	Penning			1813662	Penning	
2				2		
					l. *s.* *d.*	
6600			66|00)	36273|25	(852 12 6	*Answer.*

53. How many Pounds Sterl. are equal to 1680 Guilders at 33*s.* 3*d.* Flem. *per l.* Sterling? *Anf. l.* 168 8 $5\frac{21}{399}$.

54. In 2080 Guilders, 15 Stivers, at 34*s.* 9*d.* Flem. *per l.* Sterling, how many Pounds Sterling is it? *Anfwer, l.* 199 11 $10\frac{66}{417}$.

55. At 33*s.* 11*d.* Flem. *per l.* Sterling, I demand how many Pounds Sterling are there in 6048 Guilders? *Anfwer, l.* 594 7 $11\frac{215}{407}$.

56. 2048 Guilders, 15 Stivers, at 34*s.* 5*d.* Flemifh *per l.* Sterling, how many Pounds Sterling is it? *Anfwer, l.* 198 8 $6\frac{114}{413}$.

57. In 1000 Guilders, at $33\frac{1}{3}$*s.* Flemifh *per l.* Sterl. how many Pounds Sterling is it? *Anfw.* 100*l.*

To convert Bank-Money at Amfterdam *into current Money.*

In Holland the Money of Exchange is called *Bank-Money*, and is better than current Money by 4 or 5 *per Cent. i. e.* 100*l.* Bank-money makes 104 or 105*l.* current Money: The Difference between the Bank and current Money is called the *Agio*, as when 100*l.* Bank is worth 104*l.* Current, they fay the *Agio* is 4 *per Cent.*

Therefore Bank-Money is reduced to Current juft as *Englifh* Money is reduced to *Irifh*, and Current to Bank as *Irifh* to *Englifh*.

Example.

Guild. Stiv.
In 14230 18 Bank-Money, how much current Money, *Agio* 5 *per Cent.*?

14230 18	Or, 14230 18	Or, 14230.9
5	$5 - \frac{1}{20}$ 711 $10\frac{9}{10}$	.05
711|54 10		711.545
20	*G.* *St.*	$711.10\frac{9}{10}$
10|90	Bank 14230 18	
16	Agio 711 10 14	
14|40	Current 14942 8 14 *Answer.*	

Sect. III.

Of Exchange between England *and* Hamburgh.

England exchanges on *Hamburgh* as on *Holland* and *Antwerp*, from 32 to 35*s*. Gros or Flem. *per l.* Sterl.

Books of Accounts are kept in Marks, Sous and Deniers Lubs, and by ſome in Rixdollars, Sous or Schellings, and Deniers, and by others in *l. s. d.* Flemiſh.

The Par of Exchange between *London* and *Hamburgh* is about 35.17*s*. Flemiſh *per l.* Sterl.

12 Deniers-Lubs 2 Deniers-Gros	make	1 Sous-Lubs,
16 Sous-Lubs	make	1 Mark-Lubs,
3 Marks Lubs	make	1 Rixdollar,
$7\frac{1}{2}$ Marks-Lubs $2\frac{1}{2}$ Rixdollars	make	1 Pound Gros or Flem.
6 Deniers-Lubs	make	1 Denier Gros,
6 Sous Lubs	make	1 Shilling Gros,
8 Shillings Gros	make	1 Rixdollar,
20 Shillings Gros	make	1 Pound Gros.

To Reduce *l.* Sterl. into *l.* Gros, differ nothing from § 2.

To reduce l. Sterling *into* Marks-Lubs.

Reduce the Rate of Exchange into Sous-Lubs and multiply the *l.* Sterling thereby, and for the odd Shillings and Pence Sterl. take Parts of the Exchange, the Sum of ſaid Product and Parts will be the Anſwer in Sous-Lubs, which reduce to Marks by the Table.

58. A Bill of *l.* 254 6 8 Sterl. being drawn at London upon Hamburgh, at 32*s*. 4*d*. Gros *per l.* Sterl. how many Marks-Lubs are to be paid for that Bill?

Anſwer, 3083 Mks. 12 So. 8 Den. Lubs.

l. *s.* *d.* *l.* *s.* *d.*
1 —— 32 4 —— 254 6 8
6+4*de.*=2 *so.* 194

194 1016
2286
254
6*s.* 8*d.*—$\frac{1}{3}$*l.* $64\frac{2}{3}$

16) $49340\frac{2}{3}$ or 8*d.*

Answer, 3083 12 8

59. How many Marks Lubs are equal to 200*l.* 10*s.* at $32\frac{1}{2}$ Gros, *per l.* Sterling?

Answer, 2443 Mar. $9\frac{1}{2}$ Stivers or Sous Lubs.

60. How many Marks Lubs are in *l.* 550 15 Sterling, at 32*s.* 9*d.* Gros, *per l.* Sterling?

Answer, 6763 Marks, $14\frac{3}{8}$ Stivers-Lubs.

61. In 1000*l.* Sterl. at 32*s.* 3*d.* Gros *per l.* Sterling, how many Marks Lubs? *Answ.* 12093 Mar. 12 Stiv. Lubs.

62. In *l.* 345 10 6 Sterl. at 32*s.* 6*d.* Gros *per l.* Sterl. how many Marks Lubs?

Answer, 4211 Marks, $1\frac{3}{8}$ Stivers-Lubs.

To reduce Marks *to Pounds* Sterling.

63. 3083 Marks, 12 So. 8 Den. Lubs, how much Sterl. Money, Exchange at 32*s.* 4*d.*?

s. *d.* *Mks.* *So.* *Den.*
32 4 —— 1 —— 3083 12 8
12 16

388 Den Gros 18500
6 3084

2328 Den. Lubs 49340 So. Lubs
12

2328) 592088(254 6 8

Otherwise thus:

32 4 —— 1 —— 3083 $12\frac{2}{3}$
6 16

l. *s.* *d.*
194 So. Lubs 194) $49340\frac{2}{3}$ (254 6 8

64. In 2443 Marks, $9\frac{1}{2}$ Stivers Lubs, how many Pounds Sterl. at 32*s*. 6*d*. Gros *per l.* Sterl.? *Answ.* 200*l.* 10*s.*

65. 6763 Marks, $14\frac{3}{8}$ Stivers-Lubs, at 32*s*. 9*d*. Gros *per l.* Sterl. how many Pounds Sterling does it make?

Answer, 550*l* 15*s*.

66. In 12093 Marks, 12 Stivers-Lubs, at 32*s*. 3*d*. Gros *per l.* Sterl. how many Pounds Sterling? *Answer*, 1000*l.*

67. How many Pounds Sterl. are in 4211 Marks, $1\frac{3}{4}$ Stivers-Lubs, at 32*s*. 6*d*. Gros *per l.* Sterling?

Answer, *l.* 345 10 6.

Sect. IV.

Of Exchange between England *and* France.

England exchanges with *France* on the Crown of 3 Livres Tournois or 60 Sols, and gives Pence Sterling more or less for this Exchange Crown.

Accounts are kept in France in Livres, Sols and Deniers.

12 Deniers —— 1 Sol,
20 Sols —— 1 Livre,
3 Livres —— 1 Crown.

The Par of Exchange between England and France, is about $29\frac{3}{8}$ Sterling, *per* Crown, according to *Dowling*; *Postlewait* puts it after Sir *Isaac Newton*, $31\frac{16}{17}$

To reduce French Crowns to *Pounds* Sterling.

68. How many Pounds Sterl. are equal to 1800 *French* Crowns, Exchange at $32\frac{1}{2}$*d.* *per* Crown? *Answ.* 243*l.* 15*s*.

1800 at $32\frac{1}{2}$ or 2 $8\frac{1}{2}$

s.	d.			
2	6	— $\frac{1}{8}$ *l.*	225	
	$2\frac{1}{2}$	-- $\frac{1}{12}$	18	15
			l. 243	15

Or, 1800

		s.	d.
	180 at	2	0
$\frac{1}{3}$	60 —	0	8
$\frac{1}{16}$	3	15	
	l. 243	15	

But if the Sum to be exchanged be given in Livres, Sols and Deniers, divide them all by 3, which reduces them to Crowns, Sols and Deniers d'or, or to Crowns, and twentieths, and two hundred and fortieths of a Crown, which Denominations are of the same Form as *l. s. d.* and therefore proportionable to them. Divide these Crowns, Sols and Deniers by the Parts which 1 Crown is of 1*l. Sterl* and the Quotient or Sum of the Quotients will be the Sterling Money required.

69. In 5929 Livres, 4 Sols, how many Pounds *Sterl.* at $32\frac{1}{2}d.$ Sterl. *per* Crown?

		l.	*s.*	
	3)	5929	4	
		1976	8 at 2*s.* $8\frac{1}{2}d.$	
s.	*d.*			
2	6 — $\frac{1}{8}$	247	1	
	$2\frac{1}{2}$ $\frac{1}{12}$	20	11	9
	Answer,	267	12	9 *Sterl.*

70. How many Pounds Sterl. are in 8468 Liv. 8 So. 4 De. at 36*d.* Sterl. *per* Crown? *Answer, l.* 423 8 5.

71. How many Pounds Sterl. are equal to 1000 French Crowns, at $33\frac{1}{4}d.$ Sterl. *per* Crown?

Answer, l. 138 10 10.

72. In $1263\frac{1}{2}$ Crowns, at $32\frac{1}{2}d.$ Sterl. *per* Crown, how many Pounds Sterl is it? *Answer, l.* 171 1 $11\frac{3}{4}$.

73. How many Pounds Ster. are equal to $1037\frac{3}{4}$ Crowns, at 33*d.* Sterl. for every Crown? *Answ. l.* 142 13 $9\frac{3}{4}$.

74. In 1976 Crowns, 1 Livre, 4 Sols, at $32\frac{1}{2}d.$ Sterl. *per* Crown, how many Pounds Sterl. is it?

Answer, l. 267 12 9.

75. At $33\frac{3}{4}d.$ Sterl. *per* Crown, how many Pounds Sterl. are there in 1000 Crowns? *Answer, l.* 140 12 6.

76. How many Pounds Sterling are in 2822 Crowns, 2 Li. 8 Sols, 4 Deniers, at 36*d.* Sterl. *per* Crown?

Answer, l. 423 8 5.

To reduce English *Money into* French.

77. A Bill being drawn in *London* upon *Paris*, for 243*l.* 15*s*, at $32\frac{1}{2}d.$ *per* Crown; I want to know how many Crowns are to be paid for that Bill?

d.	*Cr.*	*l.*	*s.*
$32\frac{1}{2}$ ——	1 ——	243	15
2		20	
65		4875	
		12	
		58500	
		2	

——*Crown*

——— Crowns Liv.

65) 117000 (1800 or 5400
65
———
520
520
———

Note, If the Anſwer be required in Livres, multiply the Crowns by 3.

78. How many Crowns are equal to *l.* 138 10 10 Sterl. at $33\frac{1}{4}$*d.* Sterl. *per* Crown?

Anſwer, 1000 Crowns, or 3000 Livres.

79. In *l.* 171 1 $11\frac{3}{4}$ Sterling, how many Crowns does it make, at $32\frac{1}{2}$*d.* Sterling *per* Crown?

Anſwer, $1263\frac{1}{2}$ Crowns, or 3790 Livres, 10 Sols.

80. How many Crowns are in *l.* 142 13 $9\frac{3}{4}$ Sterling, at 33*d.* Sterling, *per* Crown?

Anſwer, 1037 Crowns, 2 Livres, 5 Sols.

81. At $32\frac{1}{2}$*d.* Sterling *per* Crown, how many Crowns are there in *l.* 267 12 9 Sterling?

Anſwer, 1976 Crowns, 1 Livre, 4 Sols.

82. In *l.* 140 12 6 Sterling, how many Crowns at $33\frac{3}{4}$*d.* Sterling *per* Crown? *Anſwer*, 1000 Crowns.

83. How many Crowns Tournois are equal to *l.* 423 8 5 Sterling, Exchange at 36*d* Sterl. *per* Crown?

Anſw. 2822 Crowns, 2 Livres, 8 Sols, 4 Deniers.

The foregoing Method is univerſal; but may be contracted in ſome Caſes, *viz.*

When the Rate of Exchange is 30*d* or 2*s.* 6*d. per* Crown, 2*s.* 6*d.* is $\frac{1}{8}$*l.* Conſequently in this Caſe every Pound Sterl. contains 8 Crowns, wherefore the *Engliſh* Money multiplied by 8, will produce the Crowns required.

Note, If the *Engliſh* Money be Pounds, Shillings and Pence, the Anſwer will reſult Crowns, Sols and Deniers d'or, which being multiplied by 3 throughout, will give the Anſwer in Livres, Sols and Deniers Tournois.

And if the Rate exceed 30*d.* by an even Part thereof, as $32\frac{1}{2}$*d.* exceeds it by $2\frac{1}{2}$, $\frac{1}{12}$ of 30, then $2\frac{1}{2}$ is contained juſt once more in the given Rate $32\frac{1}{2}$ than in the aſſumed Rate 30, *viz.* 13 Times; and $32\frac{1}{2}$ is $\frac{13}{13}$ of itſelf and 30 $\frac{12}{13}$ of the ſame. Therefore $32\frac{1}{2}$: 30 ($\frac{1}{8}$*l.* :) : : $\frac{13}{13}$ or 1 : $\frac{12}{13}$. or $1-\frac{1}{13}$: ſo that if $\frac{1}{13}$ be deducted, the Remainder will manifeſtly be in Ratio to the Crowns required as $\frac{1}{8}$ thereof. And the ſame is ſhewn of any other Rate which exceeds 30*d.* or 2*s.* 6*d.* by an Aliquot Part thereof according to the following *Rule.*

Rule.

If the Rate exceed 30*d.* by an even Part of itself deduct that Part of the *Sterling* Money from itself, which is denominated by one more than the Excess is of 30*d.* and multiply the Remainder by 8.

Examples.

How many Crowns in		243	15 at $32\frac{1}{2}$?
	$\frac{1}{13}$	18	15
		225	0
			8
Answer,	*l.*	1800	0

Accordingly let such of the foregoing as fall under this Rule be done

For $31\frac{1}{2}$	Excess	$1\frac{1}{2}$ is	$\frac{1}{20}$	deduct	$\frac{1}{21}=\frac{1}{3}\times\frac{1}{7}$
32	——	2 —	$\frac{1}{15}$	——	$\frac{1}{16}=\frac{1}{4}\times\frac{1}{4}$
$32\frac{1}{2}$	——	$2\frac{1}{2}$ —	$\frac{1}{12}$	——	$\frac{1}{13}$
33	——	3 —	$\frac{1}{10}$	——	$\frac{1}{11}$
$33\frac{1}{3}$	——	$3\frac{1}{3}$ —	$\frac{1}{9}$	——	$\frac{1}{10}$
$33\frac{3}{4}$	——	$3\frac{3}{4}$ —	$\frac{1}{8}$	——	$\frac{1}{9}$
35	——	5 —	$\frac{1}{6}$	——	$\frac{1}{7}$
36	——	6 —	$\frac{1}{5}$	——	$\frac{1}{6}$

SECT. V.

Of Exchange between England *and* Spain.

England exchanges with *Spain* on the Piastre or Piece of $\frac{8}{8}$ for an uncertain Number of Pence, Sterling.

In *Madrid*, *Cadiz*, *Malaga*, and all the Places of Trade in the *Straits*, *Mediterranean*, *Africa*, and the *West-Indies*, the *Spaniards* keep their Accounts generally in Piastres or Dollars, Rials, Half Rials and Quartiles; 16 Quartiles = 1 Rial; and 8 Rials = 1 Dollar; Or in Dollars, Rials and Maravadies, reckoning 34 Maravadies to the Rial, and 8 Rials to the Dollar.

The old Piastre is valued at 8, and the new at 10 Rials Plate.

To reduce Spanish *Money into* English.

84. How much *English* Money is equal to 4384 Dollars 3 Rials and 8 Quartiles, at $40\frac{1}{2}d.$?

	Dol.	*Ri.*	*Qu.*	*d.*
	4384	3	8	at $40\frac{1}{2}$
s. *d.*				
3 4 -- $\frac{1}{6}$	730	13	4	
$\frac{1}{2}$ -- $\frac{1}{80}$	9	2	8	
2Ri. --- $\frac{1}{4}$	0	0	$10\frac{1}{8}$	
1 ------ $\frac{1}{2}$	0	0	$5\frac{1}{16}$	
8 Qu. $\frac{1}{2}$	0	0	$2\frac{17}{32}$	
Answer, l.	739	17	$5\frac{23}{32}$	

85. Suppose *Cadiz* remits to *London* 3537 Dol. 6 Rials, at $40\frac{7}{8}$*d.* *per* Dollar, what will this remittance amount to in *England?* *Answer, l.* 602 10 $5\frac{17}{32}$.

English *into* Spanish.

86. How many Dollars or Pieces of $\frac{8}{8}$ are equal to 739*l.* 17*s.* $5\frac{3}{4}$*d.* Sterl. Exchange at $40\frac{1}{2}$ Sterl. *per* Dollar?

Answer, 4384 Dol. 3 Ri. 8 Quart.

d	*Dol.*	*l.*	*s.*	*d.*
$40\frac{1}{2}$ ———	1 ———	739	17	$5\frac{3}{4}$

87. How much *Spanish* Currency is *l* 602 10 $5\frac{1}{2}$ Sterl. Exchange at $40\frac{7}{8}$ *per* Dollar? *Answer,* 3537 Dol. 6 Rials.

Sect. I.

Of Exchange between England *and* Portugal.

England exchanges with *Portugal* on the Milrea; Accounts are kept in Milreas and Reas, 1000 Reas to the Milrea.

The Par of Exchange is about 67.166*d*, Sterl. *per* Milrea

To reduce Portugal *Money into* Sterling *Money.*

Take Parts out of the Milreas for the given Rate. And if there be odd Reas, divide the Milreas and Reas as a Number, and the Answer will be got in Pounds and thousandth Parts of a Pound, in the usual Way of Practical Operations, which may be changed into Shillings, Pence, and Farthings.

Oporto remits to *London* 4366 Mil. 183 Reas, at 5*s.* $5\frac{5}{8}$*d.* *per* Mil. how much *Sterling* is it?

Mils.

	Mils.	*Rs.*		*s.*	*d.*
	4366	.183	at	5	$5\frac{5}{8}$
s. d.					
5 0 is $\frac{1}{4}$	1091	.545	75		
5 — $\frac{1}{12}$	90	.962	14		
$\frac{5}{8}$ — $\frac{1}{8}$	11	.370	17		
	1193	.87806			
	1193	.17 $6\frac{1}{4}$			

Note, If the Reader is not versed in *Decimals*, let him divide the Milreas and Reas as 1 whole Number, and cut off the three last Figures from the Sum (which divides it by 1000,) the Figures cut off are the Remainder, *viz.* so many Thousandths of 1*l.* of which Remainder the Value may be found.

88. How many Pounds Sterling in 1000 Milreas, at 5*s.* 6*d.* *per* Milrea? *Answer*, 275*l.*

89. In 2000 Milreas, at 5*s.* $8\frac{1}{2}$*d.* *per* Milrea, how many Pounds Sterling? *Answ.* *l* 570 16 8.

90. At 5*s.* $6\frac{3}{4}$*d.* *per* Milrea how many *l.* in 2060 Mil. 380 Reas? *Answ.* *l.* 573 0 $10\frac{73}{100}$.

91. Tell me how many Pounds in 1056 Mil. 990 Reas, at 5*s.* $4\frac{1}{2}$*d.* *per* Mil.? *Answ.* *l* 284 1 $4\frac{871}{1000}$.

To Reduce Sterling *Money into* Portugal *Money.*

92. How many Milreas are equal to *l.* 1193 17 $6\frac{1}{4}$, at 5*s.* $5\frac{5}{8}$*d.* Sterling *per* Milrea?

s.	*d.*		*Re.*		*l.*	*s.*	*d.*
5	$5\frac{5}{8}$	—	1000	—	1193	17	$6\frac{1}{4} = \frac{6}{8}$
12					20		
65					23877		
8					12		
525					286530		
					8		

Mil. *Rs.*

525) 2292246,000 (1366 183 near.

93. How many Milreas are equal to 226*l.* 16*s.* the Exchange at 5*s.* 4*d.* *per* Milrea?
Answer, 850 Milreas, 500 Reas.

94. In 275*l.* at 5*s.* 6*d.* *per* Milrea, how many Milreas?
Answ 1000 Milreas.

95. How many Milreas are in *l.* 570 16 8. the Exchange at 5*s.* $8\frac{1}{2}$*d.* *per* Milrea? *Answ.* 2000 Milreas.

96. At 5*s.* 10*d.* *per* Milrea how many Milreas are there in *l.* 106 5 $6\frac{1}{4}$? *Answ.* 364 Milreas, 375 Reas.

Sect. VII.

Of Exchange between England *and* Italy.

England exchanges on *Leghorn* for the Dollars of 6 Livres, and gives Pence *Sterling* for the same, they reckon 12 Deniers to the Soldi, and 2 Soldi to the Dollar.

On *Genoa* for the Piastre of 5 Livres, they keep Accounts in Livres, Sols, and Deniers, 12 Deniers = 1 Sol, and 20 Sols = 1 Livre.

On *Venice* for the Ducat of 24 Grols Banco for Pence *Sterling*, Accounts are kept in Livres, Sols and Grofs Current, 12 Grofs = 1 Sol, 20 Sols = 1 Livre.

The Bank and Bankers keep their Accounts in Livres, Sols and Groffes Banco; 1 Livre = 10 Ducats Bank, or 12 Current, so that Current Money is of less Value than Bank Money by 20 *per Cent.*

From which it is easy to conceive that these Exchanges are calculated on the like Principles as the *French* which having explained, it doth not appear necessary to enlarge farther on this head.

PART II.

ARBITRATIONS OF EXCHANGES.

UNDER the Head of *Arbitrations of Exchanges* are comprehended first the Calculation of the Proportional Exchange of two Places by means of one or more intermediate Exchanges given, and secondly, having two or more different Routes of Exchange, to compute which is more gainful, or whether it is more advantageous to remit Money or Bills, or to draw or order a Remittance, *et Contra.*

Since *Ireland* draws all its foreign Demands by *London*, there is always one intermediate Exchange whereby to compute the Value of any foreign Sum in Irish Money according to the present Rates of Exchange, wherefore we begin with this Problem.

To reduce foreign Money into Irish.

Examples.

1. How much will 100*l. Flemish* amount to *Irish* Currency, Exchange between *London* and *Amsterdam* being 33*s.* 4*d. per l.* and between *London* and *Dublin* 8 *per Ct.* Advance?

1st Method.

s. d.	*s. Sterl.*	*l.*	*l. Sterl.*
If 33 4	20	100	*Answ.* 60
l. Eng.	*l. Irish*	*l. Eng.*	
If 100	108	60	*Answer,* $64\frac{4}{5}$.

But in this Case where a Comparison is made between one Rate and a second, between that second and a third, between the third and a fourth, &c. instead of stating each Comparison *per Rule of Three*, there is a more ready and contracted Way called the *Rule of Conjunction* for which this is the Rule.

1. Place the Antecedents on the left, and the Consequents on the Right-hand.

2. The first Antecedent and last Consequent must be of one Name or Species; so must the first Consequent and second Antecedent, the second Consequent and third Antecedent, which order must be continued through the whole.

3. The Terms being thus disposed, multiply all the Antecedents for a Divisor, and all the Consequents for a Dividend, if the Place of an Antecedent be blank: And all the Consequents for a Divisor, and all the Antecedents for a Dividend, if the Place of a Consequent be blank.

```
            s.  d.
            33  4
            12
           ----     d.
Flemish    400 = 240 English.
English    100 = 108 Irish.
Irish    ----- = 100
                -----
Divisor  40000   10800       l.      s.
                   240 Answer, 64 4/5 or 16
                -----
                 432
                216
                ------
4|0000)  259|2000
         --------
          64 32/40 | 4/5
```

And this Operation may be further contracted in the following Cases.

I. If any Antecedent and Consequent are equal, erase them; for then the Quotient or Answer will result the same.

	l		*l.*	
Flemish	$1\frac{2}{3}$	=	1	*Eng.*
English	$\cancel{200}$	=	108	*Irish.*
Irish	?	=	$\cancel{200}$	*Flemish.*

$$1\frac{2}{3}$$
$$3$$
$$\frac{5}{3} \times \frac{108}{1}$$
$$324$$

5) 324 ($64\frac{4}{5}$ *Answer.*

II. If any Antecedent and Consequent be composite to each other, Divide them by their greatest common Measure, and take the Quotients instead of the Numbers themselves.

5 $\cancel{400} = \cancel{240}$ 3
$\cancel{200} = 108$
? $= \cancel{200}$ *Answer*, $64\frac{4}{5}$ =

III. If any Term have a Fraction annexed multiply the Integral Part by the Denominator of the Fraction (adding in the Numerator) and place the result in the Room of the mixt Number and the Denominator on the opposite Side below.

5 $\cancel{1\frac{2}{3}}$ = 1
$\cancel{200}$ = 108
? = $\cancel{200}$
3

2. What is a Guilder worth at *Corke*, if the Exchange between *London* and *Rotterdam* is at 35*s.* *Flemish per l.* Sterl. and the Exchange from *Corke* to *London* at 9 *per Cent.* Advance? *Answer*, $2\frac{8}{101}$*s.*

3. When the Exchange between *London* and *Dublin* is 6 *per Cent.* Advance, and the Exchange between *London* and *Hamburgh* at 33*s.* 4*d.* Gross *per l.* Sterling; what is then a Marks Lubs worth in *Dublin?* *Answ.* $20\frac{44}{123}$*d.*

4. Received from *Jean le Fevre* of *Bourdeaux*, Acct. Sales of 400 Casks of Butter, Neat proceeds amounting to 4326 Livres. The Exchange between *London* and *Bourdeaux* being 36*d.* *per* Crown, and between *London* and *Dublin* 5 *per Cent.* what Sum *Irish* Currency must I Debit him for? *Answer*, *l.*227 2 $3\frac{3}{7}$.

5. What is a Guilder of 20 Stivers worth at *Corke*, when the Exchange between *London* and *Rotterdam* is at 33*s.* 4*d.* *Flemish per l.* Sterling and the Exchange between *London* and *Corke*, at $8\frac{1}{3}$ *per Cent.* Advance for *Corke?* *Answ.* 26*d.*

6. My Correspondent at *Lisbon* writes that he hath remitted A B of *London* for my Account 537 M. 432 Reas, Exchange at 5 $3\frac{1}{2}$*d. per* Milrea, for value whereof I draw on A B at $7\frac{1}{4}$ *per Cent.* Advance. Quere the Sum *Irish* I must receive? *Answer. l.*153 4 $3\frac{1}{4}$.

2. Irish *into* Foreign.

7. When 105*l.* in *Dublin* is worth 100 in *London*, and the Exchange between *London* and *Paris* at 36*d. per* Crown how much then in *Paris* is 12*d.* of *Dublin* worth?
Answer, $19\frac{1}{7}$ Sols.

8. When the Exchange between *London* and *Dublin* is $8\frac{1}{4}$ *per Cent.* and between *London* and *Rotterdam* 33*s.* 4*d.* *Flemish per* Pound Sterling; how much is 12*d.* of *Dublin* worth in *Rotterdam?* *Answer*, $9\frac{1}{8}\frac{7}{7}$. Stivers.

9. Remitted *George Dawson* of *London* 160*l.* 10*s.* *Irish*, Exchange at 7 *per Cent.* with orders to remit the Value to *Gerrard Lepanto* of *Cadiz* at 40*d.* Sterling *per* Dollar; I want to know what Sum *Spanish* I am Creditor for on Account of this Remittance? *Answer*, 900 Dollars.

3. Foreign Exchanges may be calculated by intermediate Rates in like Manner.

10. *London* exchanges with *Amsterdam* at $33\frac{1}{3}$*s.* *Flemish per* Pound Sterling; *Amsterdam* with *Middleburgh* at 2 *per Cent.* Advance: How stands the Exchange between *London* and *Middleburgh?* *Answ.* 34*s. per* Pound Sterl.

11. *Amsterdam* exchanges with *London* at 34*s.* 10*d.* and *London* with *Paris* at 33*d. per* Crown; what is the arbitrated Price then of a Crown at *Amsterdam?*
Answer, $57\frac{1}{4}\frac{9}{0}$*d.* *Flemish per* Crown.

12. *Amsterdam* exchanges with *London* at 34*s.* 4*d.* *per* Pound Sterling; and on *Lisbon* at 52*d.* *Flemish* for 400 Reas: How then ought the Exchange to go between *London* and *Lisbon?* *Answer*, 75 $\frac{75}{103}$*d. per* Milrea.

13 Exchange between *London* and *Amsterdam* 34*s.* 6*d.* *Flemish per* Pound Sterling; between *London* and *Paris* $31\frac{3}{4}$*d.* Sterling *per* Crown; what is the proportional arbitrated price between *Amsterdam* and *Paris?*
Answ. 54 $\frac{123}{160}$*d.* *Flemish per* Crown.

14. *Paris* on *Amsterdam* $54\frac{123}{160}d$ *Flemish per* Crown and on *London* $31\frac{3}{4}d.$ Sterling: how then ought the Exchange to go between *London* and *Amsterdam?*

Answer, 34*s.* 6*d. Flemish per* Pound Sterl.

15. *Amsterdam* exchanges on *London* at 34*s.* 6*d. Flemish per* Pound *Sterling*; and on *Paris* at $54\frac{123}{160}d.$ *Flemish per* Crown: How then ought the Exchange to go between *London* and *Paris?* *Answr.* $31\frac{3}{4}d.$ *per* Crown.

IV. Foreign Weights and Measures, &c. may be compared and arbitrated by the same Rule of *Conjunction.*

16. Suppose 4lb of A are worth 3lb of B and 5lb of B equal to 4lb of C and 6lb of C, to 5lb of D; how many Pound of D are equal to 240lb of A?

A 4 = 3 B			Contracted.		
B 5 = 4 C				~~4~~	~~3~~
C 6 = 5 D				~~5~~	~~4~~
D ? = 240 A			2	~~6~~	~~5~~
				?2)	240
12|0) 1440|0					
					120

Answer, 120*l.*

17. If 3 Yards of Cloth cost as much as $3\frac{3}{4}$ of Ratteen and $4\frac{1}{2}$ Yards of Ratteen are worth 5 Yards of Drugget? how many Yards of Drugget are then worth 27 Yards of Cloth? *Answer*, $37\frac{1}{2}$ Yards.

18. If 3 Yards in London are equal to 4 Ells in Holland, and 50 Ells in Holland cost 26*l. Flemish*; how many Pounds *Flemish* will 40 Yards in *London* come to?

Answer, $27\frac{11}{15}l.$ *Flemish.*

19. What will 1 lb of Pepper cost, if 3 lb of Cloves cost as much as 6 lb of Pepper, and $2\frac{1}{2}$ lb of Cinnamon cost as much as 4 lb of Cloves, and 3 lb of Cinnamon cost 8 Shillings? *Answer*, 10*d. per* lb.

20. If 10 lb at London be equal to 9 lb at Amsterdam; 45 lb at Amsterdam to 49 lb at Bruges, and 98 lb at Bruges to 116 lb at Dantzick; how many Pounds at Dantzick are equal to 112 lb at London? *Answer*, $129\frac{23}{25}$

21. Suppose a Merchant at Hamburgh hath Orders to procure 81 Yards of English Cloth, so that 7 Ells of Hamburgh may be procured for 3*l.* Sterling: Now if 7 Ells of France make 9 Yards of London, and 7 Ells of Holland make 4 Ells of France: and 1 Ell of Holland make $1\frac{1}{5}$ Ell of Hamburgh; how much will the said Cloth amount to at Hamburgh, the Exchange being at 33*s.* Gross *per l.* Sterl.?

Answer, 701 Ms. 10 S. $7\frac{1}{5}$ Den.

5. *Concerning the Gain or Loss by Exchange.*

Note. When the Exchange is so many Pence Sterling for some Piece of foreign Money the gain is the more, the lower the Exchange: for it is evident I can receive more French Crowns for 100*l.* when the Exchange is at 30*d.* than when it is at 33*d.*

But when the Exchange is so much *per* Pound Sterl. the higher the Exchange, the more the gain; for I can receive more Flemish Money for 100*l.* Sterling when the Exchange is at 35*s.* than at 33*s.* Flemish *per* Pound Sterling.

22. When the Exchange between London and Dublin is 7 *per Cent.* whether is it better for a Merchant here to draw a Bill on London or have Specie sent him, and what is the Difference *per Cent.*? *Answ.* Specie better by $1\frac{1}{3}$ *per Ct.*

From the Exchange of 100*l.* at Par $8\frac{1}{3}$
Take the Current Exchange 7
Remains $1\frac{1}{3}$ Gain *per Cent.*

23. A Merchant in Lisbon owes a Merchant in Dublin 850 Milreas. Which is most advantageous to Dublin to have the same sent over in Moydores of 4 Milreas, each, which pass here for 29*s.* 3*d. per* Piece; or to have it remitted to London, at 6*s.* 6*d. per* Milrea, and from London hither at 8 *per Cent.* Advance?

Answer, Moydores better by $4\frac{1}{6}$ *per Cent.*

24. A at Paris draws on B of London 1200 Crowns, at 32*d. per* Crown; for value whereof B draws again on A at 33*d. per* Crown, besides reckoning $\frac{1}{2}$ *per Cent.* for his Commission. Did A get or lose by this Transaction, and what?

Answer, He gains 30Cr. 1Liv. 12Sol 9Den.

25. A of Amsterdam owes B of Paris 2000 Guilders of current Specie, which he is to remit him, by Order, the Exchange at $60\frac{1}{2}$*d.* Flemish de Banco *per* Crown, the Agio being 4 *per Cent.*; but when this is to be negociated the Exchange suppose fallen to $59\frac{1}{2}$*d. per* Crown, and the Agio risen to 5 *per Cent.*. Did B get or lose by this turn of Affairs, and what?

Answer. 9Cr. 0Liv. 3So. 4Den. he gets.

26. Exchange between London and Dublin, being at $7\frac{1}{2}$ *per Cent.* in Dublin, and $8\frac{1}{4}$ in London, suppose A B of London, owes me 560*l.* 15*s.* English; I want to know the Difference between my drawing and his remitting me the said Sum? *Answ.* Remittance better by *l.*4 4 $1\frac{7}{15}$.

27. Suppose A of Bourdeaux owes B of Dublin 1036 Crowns, and the Exchange between Paris and London is

31½*d.* *per* Crown, between Paris and Amsterdam 56*d.* Flemish *per* Crown, and between Amsterdam and London at 34*s* 8*d.* *per* Pound Sterl. The Question is, whether B had better have the Money remitted immediately from France, or by way of Amsterdam; and what advantage he gets, admitting his Correspondent at Amsterdam is to have ½ *per Cent.* for Negotiation?

Answer, By Amsterdam better by *l.*2 15 9½ *Eng.*

INVOICES *intended for an Exercise of sundry preceding Rules.*

1. INVOICE of 49 Barrels of Beef, and 10 Hhds. of white Biscuit, shipped by me *Isaac Sharp* on Board the *Dublin Merchant*, *Nicholas Troy* Master, and consigned to *Thomas Gunston* Merchant at *Port-Royal* in *Jamaica*, for Account and Risque of *Richard Allom* of *London*, being marked and numbered as *per* Margin, Contents, Cost and Charges, *viz.*

49 Barrels of Beef, at 15*s.* 6*d.* *per* Bar. - - - *l.*

	C.	qrs.	lb.	
10 Hhds. of white Biscuit, wt.	20	0	26	at 10*s.*

N° 1 to 59 Charges.

Ω

		l.	*s.*	*d.*
TG	Custom of the Beef, —	2	9	0
	Dit. of the Biscuit, ——	0	10	0
	Entry and Fees of Cocket,	0	5	6
	Searcher and Wharfinger,	0	7	6
	Carriage of the whole,	0	9	5
	For 10 Hhds. 25*s.* Cooperage, Hoops, and Heading, 16*s.* —	2	1	0
	Porters and Shipping, —	0	3	4

l.

To my Commission, at 2½ *per Cent.*

l.

Errors excepted,

Dublin, Sept. 5, 1796.

per *Isaac Sharp*.

Supposing the Exchange 10 *per Cent.* Advance in favour of *England*, what Sum may *I, Sharp* draw for on *London*?

Answer, *l.* 54 17 3½.

Amsterdam, 7ber 10, 1796.

2. INVOICE of 10 Pieces of Holland, 9 Pieces of Cambrick, 9 Pieces of *Ghentish* Cloth, laden by me *Jonas Diligent*, on board the *Josiah*, *Thomas Cook*, Master, for the proper Risque and Account of *Henry Porter*, Merchant in *London*; marked as *per* Margin; Contents, Cost and Charges, *viz*

10 Pieces of Holland,

N° qt.	$31\frac{1}{2}$	N° qt.	$33\frac{1}{4}$
1	$33\frac{1}{4}$	6	32
to	32	to	34
5	31	10	$31\frac{1}{2}$
	$30\frac{1}{2}$		$32\frac{1}{4}$

G. Sti.

In all Ells, at 1 11 *per*

9 Pieces of Cambrick qt. $124\frac{1}{2}$ Ells, at 1 3

9 Pieces of Ghenting, qt. $105\frac{1}{2}$ ---- at 0 19

Charges.

HP

	G.	Sti.
To Custom and Brokerage of Hollands, 3Guil. *per* Piece,	30	0
To Charges in buying — — —	2	3
To Custom of Cambrick and Ghenting, — — — — —	19	11
To Sledage and Boatage — —	3	16
To Ware-house-room — — —	4	3
To average and Porterage — —	1	11

To my Commission, at $2\frac{1}{2}$ *per Cent.*

Errors excepted,
per *Jonas Diligent.*

Exchange at 24*s.* 6*d. Flemish per l.* Sterling, what doth it amount to *English?* *Answ. l.*79 9 $6\frac{18}{23}$.

Oporto, December 1, 1796.

3. INVOICE of Wine, laden *per Nicholas Strong* and *Owen Jamyn*, on Board the *Savannah*, *John Snap*, Master, for Account of *P. Lilly* and Comp. and consigned to *Paul Ludulph*, and Comp. in *Dantzick*.

		Mil.	Reas.
	To Coſt of 10 Pipes of Wine bought of *Matthew de Minis*, at 16 Mil. *per* Pipe,		
P L	To Cuſtom, at 1055 Reas *per* Pipe, —		
	To Trimming, &c. at 400 Reas *per* Pipe,		
	To Primage, at 60 Reas *per* Pipe, —		
N° 1	To Brokerage, at $\frac{1}{2}$ *per Cent.* — — —		
to 10	To Commiſſion, at 3 *per Cent.* — — —		
	To Port Charges of the ſaid Ship, — —	6	380

Errors excepted,
per *Nich. Strong* and *Owen Jamyn.*

Exc. 40 Reas for 3*d.* what Sterling? *Anſw.* 58*l.* 13*s.*

Cadiz, Oct. 17, 1796.

4. INVOICE of 1 Barrel cont. 1 Seron of Caſcarilla, ſhipped on board the *Sevilla Merchant*, Captain *Jonathan Braddel* Commander, and conſigned to *Matthew Roan*, Merchant in *London*, *viz.*

	Ry.	Fl.
1 Seron, qt. Nett 0.209$\frac{1}{4}$ lb of Caſcarilla, at 9 Pcs. $\frac{8}{8}$ *per* lb	—	
To Diſpatch, 4 Pieces $\frac{8}{8}$, is —	32	—
To Porterage to the Houſe and Boats	4	—
To Boat-hire, aboard, — —	8	—
To Brokerage, at 1$\frac{1}{2}$ *per Cent.* — —	39$\frac{1}{4}$	
To my Commiſſion at 2$\frac{1}{2}$ *per Cent.*—		

Errors excepted,
per *Samuel Dickſon.*

At 8 Ryals of Plate per Piece of $\frac{8}{8}$, what does the Whole amount to, Exchange at 52*d.* Sterling *per* Piece of $\frac{8}{8}$? *Anſw. l.* 420 10 10$\frac{3}{8}$.

5. INVOICE of 6 Hhds. of Tobacco, and 3 Bales of Woollen Cloth, ſhipt on board the *Dublin Trader*, *Nich. Dun*, Maſter, for the proper Account and Riſque of *Robt. Merchant*, of *Dublin*, and conſigned to himſelf, marked as *per* Margin, Contents, Coſt, and Charges, *viz.*

Beſt Bright Tobacco, *viz.*

C. qrs.

	C.	qrs.	lb		qrs.	lb
No 1—2	3	7	Tare	2	14
2—3	1	10	——	2	20
3—3	3	0	——	2	0
4—4	1	27	——	3	4
5—2	2	20	——	2	10
6—5	2	10	——	3	12

Tot. Gr.
Tare

lb

Trett 4 lb *per* 104

d.

lb Nt. at $7\frac{1}{2}$ *per* lb—*l.*

Cloth, 3 Bales, *viz.*
No 27, 28, 29, qt. each, 10 ſhort Cloths, at 12*l. per* —— ——

Charges.

♌ TM	To Cuſtom of all, —	*l.* 53	18	6
	To Coſt of 3 Wrappers,	0	10	6
	Storage, ——	1	0	0
	Cartage and Porterage,	0	10	6
	Brokerage, at $\frac{1}{2}$ *per Cent.*—			
				l.

To my Commiſſion, at $2\frac{1}{2}$ *per Cent.*—

Errors excepted in *London*,
Novem. 4, 1796, per
George Truſty.

Now ſuppoſe ſaid *Truſty* draws upon *Merchant* for the Value of this Factory, at $7\frac{3}{4}$ *per Cent.* how much doth it come to? *Anſwer, l.* 530 19 $8\frac{1}{2}$.

CHAP VIII.

BARTER.

BARTER or *Truck* is the exchanging of Wares Value for Value, according to the Rates or Prices agreed upon.

Questions relating thereto are solved by the *Rule* of *Three*, or the contracted Method of *Practice* instead thereof, *viz.* 1st, If a given Quantity of Goods at a given Price are proposed to be bartered for other Goods at a given Price, it is plain, I must find the Price of those Goods, of which the Quantity is given; and 2*dly*, what Quantity of the Goods to be received in Exchange, at the Price they are Rated at, will amount to the same Value, &c.

Examples.

1. A Merchant Barters 10 Pieces of Drugget, each 25 Yards, at 18$\frac{1}{2}$*d. per* Yard, against Pepper, at 15*d.* the lb. The Question is, how many Pounds of Pepper he must receive? *Answer*, 308$\frac{1}{3}$ lb.

Solution.

10 Pieces, each 25 Yds. are 250 Yds. (166) which at 18 $\frac{1}{2}$ come 4625*d.* Therefore he must receive Pepper, at 15*d. per* lb to the Value of 4625*d.* So then say 15*d.* : its Value 1 lb : : 4625 : its Value, *viz.* 308$\frac{1}{3}$ lb.

10 Ps.
each 25 Yards,
is 250 Yd. at 1 6$\frac{1}{2}$
6*d.* is $\frac{1}{2}$ 125
$\frac{1}{2}$ — $\frac{1}{12}$ 10 5
lb
15 — 1 — 385 5
12
15) 4625 (308$\frac{1}{3}$
45
125
120
$\frac{5}{15}$ | $\frac{1}{3}$

2. How much Sugar, at 8*d. per* lb, must be delivered for 20*C.* of Tobacco, at 3*l. per Cwt.*?
Answer, 16*C.* 0*qrs.* 8 lb.

3. *A* gives *B* 250 Yards of Drugget, at 18$\frac{1}{2}$*d. per* Yard, for 308$\frac{1}{3}$ lb of Pepper; I demand what the Pepper stands him in *per* lb? *Answer*, 15*d.*

4. A Merchant hath 1000 Yards of Canvas, at 9$\frac{1}{2}$*d.* the Yard, which he barters for Serge, at 10$\frac{1}{4}$*d. per* Yard; how many Yards must he receive? *Answ.* 926$\frac{34}{41}$ *Yds.*

5. *A* hath 1200 Stone of Tallow, at 2*s* 3$\frac{1}{4}$*d. per* Stone; *B* has 110 tanned Hides, wt. 3994 lb. 5$\frac{1}{4}$*d. per* lb; and they barter at these Rates. Tell me how much Money *A* is to receive of *B* besides the Hides? *Answ. l.* 40 11 2$\frac{1}{2}$.

6. *B* delivered 3 Hogsheads of Brandy, at 6*s*. 8*d*. *per* Gallon, to *C* for 126 Yards of Cloth, what was the Cloth *per* Yard? *Answer*, 10*s*.

7. *A* has Silk of 14*s*. *per* ℔, *B* has Cloth of 10*s*. *per* Yd. which he barters at 12*s*. 6*d*. the Yard, at how much must *A* put his Silk to make his Profit equal with *B*?

Answer, 17*s*. 6*d*.

	s.	s. d.	s.
If	10 ——	12 6 ——	14

Or thus,

s.	d.
12	6
10	0

If 10—2 6—14 comes 3 6

		14
Answ.	17	6

8. *A* hath Linen Cloth worth 20*d*. *per* Ell ready Money; but in Barter he will have 2*s*. *B* has Broad-cloth worth 14*s*. 6*d*. *per* Yard ready Money; at what Price ought the Broad-cloth to be rated in Barter? *Answ.* 17*s*. $4\frac{4}{5}$*d*.

9. *C* has Candles at 6*s*. *per* Dozen ready Money, but in Barter he will have 6*s*. 6*d*. *per* Dozen; *D* has Cotton at 9*d*. *per* Pound ready Money: What Price must the Cotton be at in Barter; and how much Cotton must be bartered for 100 Dozen of Candles?

Answ. The Cotton $9\frac{3}{4}$*d*. *per* lb in Barter, and 7*C* 16lb of Cotton must be given for 100 Dozen of Candles.

10. *A* has Coffee, which he barters with *B*, at 10*d*. *per* lb more than it Cost him, against Tea, which stands *B* in 10*s*. *per* lb, but puts it to $12\frac{1}{2}$*s*. I would know how much the Coffee did cost at first? *Answ.* 3*s*. 4*d*.

11. *B* has 5 Tons of Butter, at *l*. 25 10 *per* Ton; and $10\frac{1}{2}$ Ton of Tallow, at 33*l*. 15*s*. *per* Ton; which he barters with *C*, thus, to have *l*. 150 1 6 in Money and the rest in Beef, at 21*s*. *per* Barrel. How many Barrels is he to receive? *Answer*, 316 Barrels.

		l.		l.	s.	d.
5	Ton at	$25\frac{1}{2}$	is	127	10	0
$10\frac{1}{2}$	Ton at	$33\frac{3}{4}$	is	354	7	6
				l. 481	17	6
		In Cash		150	1	6

s.		Bar.					Bar.
If 21	——	1	——	331	16	0	*Answer*, 316.

12. *A* and *B* barter, *A* hath 41*C.* of Hops, at 30*s. per* Cwt. for which *B* gives him 20*l.* in Money, and the rest in Prunes, at 5*d. per* lb; what Quantity of Prunes did *B* give *A?* *Answer*, 17*C.* 3*qrs.* 4lb.

13. Two Merchants barter, *A* has 20*C.* of Cheese, at 21*s.* 6*d. per Cwt. B* has 8 Pieces of *Irish* Cloth, at 3*l.* 14*s. per* Piece; which of them must receive Money, and how much? *Answer*, *B* must receive 8*l.* 2*s.*

14. *A* has 5 Bales of Pepper, Wt. Neat 1600lb, at 17*d. per* lb which he barters with *B* for two Sorts of Goods, the one at 5*d.* the other at 8*d. per* lb, to have $\frac{1}{3}$ in Money, and of each sort of Goods an equal Quantity: I demand how many lb of each sort of Goods he is to receive, and how much in Money?

Answer, $1394\frac{34}{39}$lb and *l.* 37 15 $6\frac{2}{3}$ in Money.

15. Two Merchants barter; *C* has 10 Hhds. of Madder qt. Neat 90*C.* 3*qrs.* 14lb which cost 38*s.* 6*d. per Cwt.* and he puts it at 42*s. per Cwt.* and receives of *D* $\frac{1}{4}$ in ready Money, and the rest in Hemp, which cost 34*s.* 10*d. per* Cwt. Tell me how much Money and Hemp *C* is to receive, and what *D* ought to rate his Hemp *per* C. to make the Barter equal?

Answer, *C* must receive in Money *l.* 47 14 $2\frac{1}{4}$, and 73*C.* 0*qrs.* $5\frac{115}{209}$lb of Hemp, at 39*s.* 2*d. per* Cwt.

Note, The above Question is taken from *Foster*, who makes the Quantity of Hemp 75*C.* 1*qr.* $9\frac{1}{38}$lb; But according to this Solution the Barter doth not appear equal to me, since *C* according thereto, hath a Profit upon the Whole, and *D* only on $\frac{3}{4}$ of the Value.

CHAP. IX.

PROFIT AND LOSS.

1. BOUGHT a piece of Cloth; long 53 Yards, at 12*s. per* Yard. Sold the same at 14*s.* the Yard, What is the Profit upon the whole Piece? *Answer*, *l.* 5 6.

Sold for ——— 14*s. per* Yard,
Bought for ——— 12*s.* do.
Whereby is gained 2 *per*

	Yd.		*s.*		*Yds.*		*s.*	*l.*	*s.*
Therefore	1	———	2	———	53	:	106 or	5	6.

2. Bought 18*C.* of Cheese, at 28*s. per* Cwt. which I sell out again at $3\frac{1}{2}$*d. per* lb. What is the Profit in the Whole? *Answer*, 4*l.* 4*s.*

3. If 980lb of Merchandizes are bought for *l.* 61 5. and sold for *l.* 69 8 4; I demand the Profit upon each lb?

Answer, 2*d.*

4. Bought 12 Hhds. of Wine, at *l.* 10 5 the Hogshead, paid for Cellerage and other Charges 4*s.* 6*d.* *per* Hogshead; sold the Hogshead for 37 Crowns, each, (at 5*s.* 5*d.*) I demand the Profit or Loss? *Answer*, *l.* 5 9 Loss

Sect. II.

5. If a Ton of Tallow cost 20*l.* and is sold for 22*l.* 10*s.* I demand the Profit *per Cent.*? *Answer*, $12\frac{1}{2}$*l.*

Sold for —— $22\frac{1}{2}$
Bought for 20

If 20 gain : $2\frac{1}{2}$——100 *Answer*, $12\frac{1}{2}$.

6. If I buy a Pound of Cloves for 6*s* 3*d.* and sell it for 6*s.* How much *per Cent.* Loss is it? *Answ.* 4 *per Cent.*

7. Bought 1000 Barrels of Wheat, at 10*s.* *per* Barrel, paid for divers Charges 10*l.* How much *per Cent.* is gained if it is sold at $11\frac{1}{4}$*s.* *per* Barrel? *Answ.* $10\frac{5}{17}$ *per Cent.*

8. If 1lb of Pepper is sold for $10\frac{1}{2}$*d.* then there is lost 2*d.* *per* lb. How much is the Loss *per Cent.*?

Answ. 16 *per Cent.*

9. When I sell a Pound of Silk for 26*s.* and 6*d.* I gain 2*s.* 6*d.* Now I want to know how much I would gain if I sold a Bale of Silk which cost 120*l.*? *Answ.* 12*l.* 10*s.*

Sect. III.

10. If 1 Tun of Wine cost 40*l.* for how much must it be sold to gain $6\frac{1}{4}$ *per Cent.*? *Answer*, 42*l.* 10*s.*

100 $106\frac{1}{4}$ 40 *Answer*, 42*l.* 10*s.*

Or thus,

100 $6\frac{1}{4}$ 40 *Answer*, 2 10
6 40
42 10

11. If 100lb Weight of any Commodity cost 30*s.* at what Price must 1lb Weight of that commodity be sold to gain after the Rate of 10*l.* for every 100 laid out?

Answer, $3\frac{24}{25}$*d.*

12. Having bought 18 Gallons of Brandy for 12*l.* how may I sell 1 Gallon and gain at the Rate of 8 *per Cent.*?

Answer, 14*s.* $4\frac{4}{5}$*d.*

13. Having sold 10 Yards of Cloth for 4*l.* 16*s.* and thereby gained at the Rate of 10 *per Cent.* what was the Prime cost of 1 Yard? *Answ.* 8*s.* $8\frac{8}{11}$*d.*

14. At what Rate must I sell a Cwt. of Madder, which cost *l.* 3 15, to gain 10 *per Cent.?* *Answ.* *l.* 4 2 6.

15. At what Rate must the aforesaid Madder be sold to lose 10 *per Cent.?* *Answer*, *l.* 3 7 6.

16. Bought 12 Pieces of white Cloth for *l* 6 10 *per* Piece: paid 20*s.* 10*d.* a-piece for Dying: for how much must I sell them a piece to gain 20 *per Cent?* *Ans.* *l.* 9 1.

17. Suppose I buy 28 Pieces of Stuff, at 4*l* *per* Piece, and sell 10 Pieces at 6*l.* and 8 at 5*l.* at what Rate must I sell the rest to gain 10 *per Cent.* by the whole?

Answer, *l.* 2 6 5 nearly.

18. Having sold a Yard of Cloth for 11*s.* 6*d.* I gained at the Rate of 15 *per Cent.* but if I had sold it for 12*s.* what should I gain *per Cent.?* *Answer*, 20.

19. Bought 7 Tuns of Wine, at 17*l.* *per* Hhd. which I sell at 1*s.* *per* Pint, what is the whole gain, and how much *per Cent?*

Answer, The whole Gain *l.* 229 12, and *l.* 48 4 $8\frac{1}{2}$ *per Cent.*

Sect. IV.

20. Bought a Tun of Wine for 50*l.* ready Money; sold it for 54*l.* 10*s.* payable in 8 Months Time. I demand how much *per Cent. per Annum* I gain?

$$\begin{array}{ccccc} & & 54\frac{1}{2} & & \\ & & 50 & & \\ 50 & > & 4\frac{1}{2} & < & 100 \\ 8 & & & & 12 \end{array}$$

Answ. $13\frac{1}{2}$.

The Work may be contracted in like Manner; see *Case* IV. *p.* 91, *viz.*

$$\begin{array}{ccccccc} 1 & 5\cancel{0} & & & & \cancel{1}\cancel{0}\cancel{0} & \cancel{2} \\ \cancel{2} & \cancel{8} & > & 4\frac{1}{2} & < & \cancel{1}\cancel{2} & 3 \end{array}$$

21. Having bought a Parcel of Goods for 18*l.* and sold the same immediately for 25*l.* with 4 Months Credit: What is gained *per Cent. per Annum?* *Answer*, $116\frac{2}{3}$.

22. Bought 300lb of Coffee, at 4*s.* 2*d.* *per* lb ready Money, and sold for 5*s.* *per* lb payable in 8 Months. I want to know how much was gained upon the Whole, allowing Discount at 6 *per Cent. per Annum*; and how much *per Cent. per Annum* was gain'd?

Answ. *l.* 9 12 $3\frac{9}{13}$ upon the whole, and 30 *per Cent.*

23. Bought 40 Gallons of Brandy, at 3*s.* *per* Gallon: by Accident 6 Gallons of it is lost, at what Rate may I sell the

the reſt, with 8 Months Credit, and gain upon the whole Prime Coſt at the Rate of 10 *per Cent. per Annum?*

Anſwer, 3*s*. $9\frac{3}{17}$*d*. *per* Gallon.

24. Bought 100 Yards of Cloth, at 14*s*. *per* Yard, which I propoſe to ſell for ready Money, at 25 *per Cent.* Profit; and if I ſell upon Time to have moreover 5 *per Cent. per Annum* for Forbearance: How muſt I ſell it *per* Yard, at 6 Months, to make both theſe gains? *Anſw.* 17*s*. $11\frac{1}{2}$*d*.

25. Bought 100 Caſks of Raiſins, at 50*s*. *per Cwt.* payable in 9 Months, ſold them for 52*s*. *per Cwt.* payable in 15 Months; what is the Profit *per Cent. per Annum* at that Rate? *Anſw.* 8 *per Cent.*

15 *Mo.*	52*s*.		
9 *Mo.*	50*s*.		
6 *Mo.*	*s*. 50	2	100
	Mo. 6		12 *Anſw.* 8 *per Cent.*

26. A Vintner buys a parcel of Brandy at 5*s*. 3*d*. *per* Gallon, payable in 6 Months; ſells the ſame at 5*s*. $10\frac{1}{2}$*d*. *per* Gallon, payable in 10 Months. How much *per Cent.* does he gain at that Rate *per Annum?*

Anſwer, $35\frac{5}{7}$ *per Cent.*

27. If 1 *Cwt*. of Merchandize are bought for 56*s*. payable in 9 Months Time, and ſold for $6\frac{1}{4}$*d*. the Pound, payable in 12 Months Time. I demand what he gains *per Cent.* in a Year at that Rate? *Anſwer*, $16\frac{2}{3}$*l*.

28 A Tobacconiſt buys 10 Hhd*s*. of Tobacco, Wt. neat 30*C*. 3*qrs*. 14lb, at $9\frac{1}{4}$*d*. *per* lb payable in 3 Months, ſells it for 11*d*. Half-farthing, payable in 7 Months. Tell me how much *per Cent. per Annum* is gained at that Rate?

Anſwer, $60\frac{30}{37}$.

Sect. V.

29. Received from London 11300lb of Pewter, coſt 706*l*. 5*s*. *Engliſh* Money, the Charges here are *l*. 10 6 8, at what Rate muſt I ſell it a Pound to gain 15 *per Cent.* allowing 12*d*. in *England* to make 13*d*. in *Ireland?*

Anſw 19*d*. very near, or exact $18\frac{42483}{45200}$*d*.

s.	*d*.	*l*.	*s*.	*d*.		*l*.	*s*.	*d*.
1 ——	$1\frac{1}{12}$ ——	706	5		comes	765	2	1
		58	17	1	Charges	10	6	8
		765	2		whole coſt	775	8	9
100 ——	15 ——	775	8	9	comes	116	6	$3\frac{1}{4}$
						l. 891	15	$0\frac{3}{4}$

11300 —— 891 15 $0\frac{3}{4}$ —— 1 *Anſwer*, $18\frac{42483}{45200}$*d*.

30. A Merchant receives from *Lisbon* 180 Casks of Raisins, which stand him here in 16*s.* each; trucks them against other Merchandizes, at 28*s. per C.* finds to have gained 25 *per Cent.* Profit. I demand the Weight of each Cask, one with another? *Answer*, 80lb.

31. I sell Barley at 6*s. per* Kilderkin, and gain 20 *per Cent.*; now if I sell a Parcel of the same Barley, amounting to 3*l.* 15*s.* and find I gain 50 *per Cent.* tell me how many Barrels were in the last Parcel?

Ans. 10; and at what Rate I sold them? *Ans.* At $7\frac{1}{2}$*s.*

32. Received 3 Pieces of Holland; qt. No. 1, 42 Ells, at $15\frac{1}{4}$ Stivers the Ell; No. 2, 52 Ells, at $19\frac{3}{8}$ Stivers the Ell; No. 3, $64\frac{1}{2}$ Ells, at $20\frac{1}{2}$ Stivers the Ell. At how much must I sell it the Yard, one with another to gain 20 *per Cent.* allowing $10\frac{1}{2}$ Stivers for 1*s.* Sterling, and that 3 Yards make 4 Ells? *Answer*, 2*s.* $10\frac{2962}{11697}$*d.*

33. A Merchant sends to *Barbadoes* 300 Firkins of Butter, Wt. 175 *C.* 2 *qrs* 19 lb. at 18*s.* 8*d. per C.* pays for Duty and other Charges, 11*l.* 0*s.* 10*d*; his Correspondent at *Barbadoes* sells the Butter at 6*d.* the Pound, (Weight as above) pays for Freight, &c. *l.* 24 17 1; takes 5 *per Cent.* for the Commission; I demand the Loss or gain, if 135*l. Barbadoes* is worth but 100*l* in *Ireland*?

Answer, *l.* 152 14 $5\frac{19}{27}$ Profit.

C.	*qrs*	lb		*s.*	*d.*		*l.*	*s.*	*d.*
175	2	19	at	18	8	*per C.*—	163	19	2
						Charges	11	0	10
						First Cost	175	0	0

C.	*qrs.*	lb			*l.*	*s.*	*d.*
175	2	19	at 6*d.*	the lb—	491	17	6
Charges, 24	17	1					
Commission, 24	11	$10\frac{1}{2}$					
					49	8	$11\frac{1}{2}$
				The neat Proceeds,	442	8	$6\frac{1}{2}$

				l.	*s.*	*d.*
If 135——100——442 8 $6\frac{1}{2}$	come			327	14	$5\frac{19}{27}$
	The first Cost,			175	0	0
		Profit,	*l.*	152	14	$5\frac{19}{27}$

34. Sent to Rotterdam 500 Salt Ox hides, Wt. Neat, 400 *C.* 2 *qrs.* 14 lb; cost 20*s.* 4*d. per C.* paid for Duty and other Charges, *l.* 15 10 3; when the Hides arrived, they weighed 39370 lb and my Correspondent sells them for 15 Guilders the 100 lb; deducts for Freight and other Charges, 650 Guilders, $17\frac{4}{5}$ Stivers, and for his Commission

2 *per Cent.* Now tell me whether I gain or lose, if I value each Guilder at 2*s.*? *Answer*, I gain *l.* 90 16 $8\frac{1}{2}$.

35. A Merchant sends to *Bourdeaux* 200 Barrels of Beef, which cost him 20*s.* *per* Barrel and 400 Casks of Butter, Wt. Neat, 600*C.* 2*qrs.* 0lb, at 20*s.* 4*d.* *per C.*; pays for Duty and other Charges, *l.* 45 10 6; the Correspondent in *Bourdeaux* sells the Beef for 16 Livres the Barrel, and the Butter for 20 Livres the 100lb (Wt. 67850lb.) Deducts for Charges, 1500 Livres, and 2 *per Cent.* for his Commission, Now if the Merchant values each Livre at 16*d.* to know whether he gets or loses?

Answer, He gains *l.* 139 12 $1\frac{3}{5}$.

36. A Merchant in *Ireland* sent to *Lisbon* 500 Barrels of Wheat cost $10\frac{1}{2}$*s.* *per* Barrel; 200 Firkins of Butter, Wt. 110*C.* 2*qrs.* 14lb, at 18*s.* 8*d.* *per C.*; and 400 Tanned Hides, Wt. 106*C.* 3*qrs.* at $5\frac{3}{4}$*d.* per lb; paid for Duty and other Charges *l.* 35 16 1, and pays Premium of Insurance of 688*l.* at 16 *per Cent.* The Wheat at *Lisbon* measured 5000 Alquires, and is sold for 300 Reas the Alquire; the Butter, Wt. 387 Arobes and 6lb and it is sold at 80 Reas the lb; the Leather, Wt. 373 Arobes and 20 lb, and sells for 150 Reas the lb; the Factor pays for Duty and other Charges, 832 Mil. 62 Reas, and charges for his Commission 3 *per Cent.*; the Factor remits the Neat Proceeds to *London*, at 5*s.* 6*d.* *per* Milrea, and the Merchant in *Ireland*, draws it from *London* at 5 *per Cent.* Advance. I demand whether he gets or loses by this Cargo?

Answer, He gains *l.* 161 14 6.

Note, Every Arobe is 32lb.

37. A Merchant in *Ireland* sends to *Ostend* 20 Hhds. of Tallow, Wt. 10 *Ton* 17*C.* 3*qrs.* at *l* 30 10 9 the Ton; pays for Duty and other Charges, 25*l.* 10*s.* and for Premium of Insurance, 55*l.* 10*s.* The Tallow arriving at *Ostend*, Wt. 24388lb, and the Merchant there sells it at 18 Guilders the 100lb; pays for Freight, Duty and other Charges, 595 Guilders, 10 Stiv. 4 Pennings, and reckons for his Commission 2 *per Cent* and remits the Neat Proceeds to *London*, at 33*s.* 9*d.* *Flemish per l.* Sterling, and the *Irish* Merchant draws it from *London*, at 4 *per Cent.* Advance, To know whether he gets or loses?

Answer, He loses *l.* 32 15 $1\frac{886429}{1330000}$.

CHAP. X.

FELLOWSHIP.

THE Intent of this Rule is principally to divide the Gain or Loſs made by a Trade in Partnerſhip (where the Stocks are unequal) proportionably among the Partners, *viz.* in Proportion to their reſpective Stocks.

Rule.

Add all the given Stocks into one Sum then it will be, as the whole Stock, is to the whole Gain or Loſs, ſo is each Man's particular Stock, to his Particular Gain or Loſs.

Examples.

1. *A* and *B* buy certain Merchandize, amounting to 80*l.* of which *A* pays 30*l.* and *B* 50*l.* and they gain by ſaid Goods 20*l.* Now I would know each Man's Share of the Profit in Proportion to the Sum he puts in?

Anſwer. A's 7*l.* 10*s.* *B's* 12*l.* 10*s.*

A's Stock 30
B's——— 50
—— 80

1*ſt*, If 80 gain 20 what 30? *Anſw.* 7 10
2*dly*, ——80 ——20 —— 50 —— 12 10
Profit *l.* 20 0

But ſince the Operation muſt be repeated for every Man's Share, the Work may be often much contracted and facilitated by applying Decimals and thereby finding a common Multiplier, by which if we multiply each Man's Stock, his Gain or Loſs will be produced, *viz.*

l. *s.* *l.*
As 80 gain 20 what 1
8|0) 200|0
25 Com. Multiplier, being the Gain of 1*l.*

30	50
.25	.25
7.50 or 7 10	12.50 or 12 10

The ſame may be effected by Vulgar Fractions, thus,

80——20——1, *Anſw.* $\frac{1}{4}$ —— $\frac{1}{4}$ 30 = 7 10; $\frac{1}{4}$ 50 = 12 10

2. *A* and *B* have gained by Merchandize 182*l.* *A* did put in 300*l.* and *B* 400*l.* I demand each of their Shares of the Profit? *Answer*, *A* 78, and *B* 104*l.*

3. A Merchant being deceas'd, it is found he owes to A 500*l.* to B 900*l.* though he left but 1100*l.* behind him: I demand how much each is to have in Proportion of his Debt? *Answer*, A $392\frac{6}{7}$, and B $707\frac{1}{7}$*l.*

4. A, B and C, freight a Ship from the *Canaries* for *England* with 108 Tuns of Wine, of which A had 48, B 36, and C 24; the Mariners meeting with a Storm at Sea, were constrained for the safety of their Lives, to cast 45 Tun thereof overboard: Here the Question to be resolved is, how many of the 45 Tun every Particular Merchant has lost according to the Rate of his Adventure?

Answer, A 20, B 15, and C 10 Tun.

5. A Chapman breaking owes unto 4 Men the following Sums of Money, *viz.*

		l.	*s.*	*d.*
To	A	21	9	6
	B	72	19	3
	C	114	13	9
	D	264	17	6
Sum		474	0	0

His whole Estate is found to be but *l.* 148 2 6; what must each have of the same, and what will it be *per l.?*

		l.	*s.*	*d.*
Answer,	A	6	14	$2\frac{1}{2}$
	B	22	16	0
	C	35	16	$9\frac{1}{4}$
	D	82	15	$5\frac{3}{4}$

at 6*s.* 3*d.* *per l.*

6. Three Butchers pay among them 40*l* for a Grass Inclosure into which they put 300 Cows, whereof A had 80, B 100, and C 120; how much had each to pay?

Answ. A *l.* 10 13 4; B *l.* 13 6 8; and C 16*l.*

7. A Father left his Estate of 1000*l.* among 3 Sons, in such Manner that for every 2*l.* that A gets, B shall have 3, and C 5; how is the Estate to be divided?

Answ. A's Share 200*l.* B's 300*l.* C's 500*l.*

8. Four Men traded with a Stock of 800*l.* and they gained in 2 Years Time twice as much and 40*l.* more; A's Stock was 140*l.* B's 260, C's 300*l.* I demand D's Stock, and what each Man gained by Trading?

Answer, D's Stock was 100*l.* and A gain'd 287*l.* B 533, C 615, and D 205*l.*

9. A, B and C put in Money together; A put in 20*l.* B and C put in 85; they gain'd 63*l.* of which B took up 21*l.* What did A and C gain, and B and C put in?

Answer, A gain'd 12*l.* and C 30*l.*
B put in 35*l.* and C 50*l.*

10. A, B and C put in Money together; A put in 20*l.* B 30*l.* C a Sum unknown; they gained 36*l.* C took up 16*l.* what did A and B gain, and C put in?

Answer, A gain'd 8*l.* and B 12, and C put in 40*l.*

11. Two Merchants have gained 450*l.* of which A is to have 3 times as much as B. How much is each to have?

Answer, A 337*l.* 10*s.* B 112*l.* 10*s.*

SOLUTION.

It is manifest from the Question that 450*l.* is to be divided in proportion as 3 to 1. Therefore

3
1
—
4 — 450 < 3, 1

		l.	*s.*
Answer,		337	10
		112	10

12. Three Persons are to share 600*l.* A is to have a certain Sum, B as much again as A, and C three times as much as B, I demand each man's Part?

Answer, A $66\frac{6}{9}$*l.* B $133\frac{3}{9}$*l.* and C 400*l.*

13. Three Persons have gained 1320*l*; now when A takes 6*l.* B takes 4*l.* and C 2*l.* I demand how much each gets? *Answer*, A 660, B 440, and C 220*l.*

14. A, B and C shipped off sundry Goods in Company to have their gains upon the whole in Proportion to their Inputs, *viz.* A put in 80 Pieces of Serge, valued at 5*l.* 10*s.* *per* Piece; B 70 Pieces of Frize, at 4*l.* *per* Piece; and C 90 Pieces of Stuff, at 2*l.* 10*s.* C paid Charges of Shipping on the whole 27*l.* 10*s* and consigned them to his Correspondent at *Lisbon*, by whose Account of Sales the neat Proceeds appear to be 3416 Mil. 600 Reas, which he remits to C's Correspondent at *London*, at 5*s.* 6*d.* *per* Milrea; and C draws on *London*, at $7\frac{3}{4}$ *per Cent.* It is required to divide the neat Amount rateably among the Adventurers?

		l.	*s.*	*d.*
Answer,	A	458	0	$10\frac{428}{778}$
	B	291	9	$7\frac{626}{778}$
	C	262	17	$1\frac{112}{778}$.

15. *A* ships off 500 Barrels of Beef worth 20*s.* *per*, belonging to *B*; and 250 Casks of Butter of his own, Wt. 313 *C.* 0 *qrs* 21 lb. at 21*s* 6*d.* *per C.* and it was agreed between them to run equal Risques in the whole, the Loss or Gain to be divided in Proportion to their Outsets; *A* paid *l.* 23 6 5 $\frac{3}{4}$ Charges on them which is to be reckoned as so much Stock. The Goods he consigned to his Correspondent in *Bourdeaux*, who returns Account of the neat Proceeds amounting to 11425 Livres and by his Order sends in Return 30 Hhds. of Wine, which cost 80 Livres *per*, and 4 Casks of Indigo. Wt. Gross 2078 lb. Tare 37 lb. per Cask, at $2\frac{1}{2}$ Livres *per* lb neat; when these Goods arrive *A* pays Duty and Charges on them *l.* 46 10 $0\frac{3}{4}$, and afterwards sells the Wine at 9*l* *per* Hhd and the Indigo at 5*s.* 10*d.* *per* lb, (100 lb at *Bourdeaux* being 110 here) and the Ballance his Correspondent in *Bourdeaux* remits to *Amsterdam*, at 54*d.* *per* Crown; which his Correspondent at *London* draws for at 35*s.* *Flemish per l.* Sterl. and remits to him here at $8\frac{1}{2}$ *per Cent* deducting $\frac{1}{2}$ *per Cent.* for his Commission; so that it comes here *l.* 194 6 6 neat. It is required to find what *A* must pay *B* for his Share of the neat Amount of this Adventure, being allowed $2\frac{1}{2}$ *per Cent.* Commission on the Sale of the Returns, and what each gained thereby?

Answer, *A* must pay *B* 590*l.* who gains 90*l.*
A gains 64*l.* 16*s.* and Commission *l.* 22 4 $7\frac{1}{4}$

☞ The following Questions usually solved by *Position* may be more easily effected by the proceeding Problem, *viz.*

16. The Sum of the Ages of *A*, *B* and *C* is 154 Years: *B* was as old as *A* and $\frac{1}{2}$ as old again; and *C* twice as old as *B*: I den and each Man's Age?

By considering this Question, I discover that *A*'s Age is in Proportion to *B*'s as 1 to $1\frac{1}{2}$, and to *C*'s as 1 to 3: Therefore it is required to Divide 154 in proportion to 1, $1\frac{1}{2}$, and 3, *viz.*

$$\begin{array}{l} 1 \\ 1\frac{1}{2} \\ \underline{3} \\ 5\frac{1}{2} \end{array} \; : \; 154 \; :: \; \begin{array}{lll} 1 & : 28 & A\text{'s Age.} \\ 1\frac{1}{2} & : 42 & B\text{'s} \\ 3 & : 84 & C\text{'s} \end{array}$$

17. A Gamester loses in 4 Turns of Dice 160 Shillings, and trebled each Turn the Sum he put in. How much did he play for the first and last Time? *Answ.* 4*s.* and 108*s.*

18. Forty Yards of Drugget and 50 Yards of Cloth cost 24*l.* 10*s.* but every Yard of Cloth double as much as a Yard of Drugget: I demand what the Drugget cost *per* Yard? *Answ.* 3*s* 6*d.*

19. Divide 15 into two such Parts, that when the greater is multiplied by 4 and the lesser by 16, their Product must be equal? *Answer,* 12 and 3.

I discover that the Numbers required must have the same Proportion to each other, the less to the greater, as 4 to 16, consequently 15 must be divided into Parts in proportion to 4 and 16, *viz.* 3 and 12.

20. A Master hires a Journeyman on this Condition, that he shall have 12*d.* a Day and his Diet for every Day he works; but for every Day he doth not work he is to pay him 6*d.* for his Diet. Now on the 30th Day they come to Account, but neither of them receives or pays any Money: How many Days did he work and how many was he idle?

Answer, He work'd 10 Days and was idle 20.

21. What Numbers are they which when added, will make $266\frac{2}{3}$, and when one is multiplied by 3 and the other by 5 the Sum shall be equal? *Answer,* $166\frac{2}{3}$ and 100.

FELLOWSHIP WITH TIME.

WHEN Stocks continue unequal Time in Company, so that Consideration is made of the Time as well as Stock, this is called *Fellowship with Time*; for which this is the

Rule.

Multiply each Man's Stock by his Time, and add the Products into one Sum; Then divide the total Gain or Loss in Proportion to these Products.

Application.

1. Suppose two Merchants *A* and *B* to be Partners in Traffick, and that *A* permits his Stock of 100*l.* to be employed in their joint Traffick 3 Months, and *B* his Stock of 50*l.* 8 Months, and they gain 28*l.* I demand how much hereof belong to each?

	100 *A*'s Stock	50 *B*'s Stock,
Multiply by	3 — Time.	8 — Time.
produce	300	400
	400	

700 —— 28 { 300 / 400   *l.*   *Answ.* 12 *A*'s Gain. / —— 16 *B*'s Gain.

2. Two Merchants made a Company; *A* put in 100*l.* for four Months and *B* put in 136*l* for three Months, and they gain 50*l.* I demand each Man's Share of the Profits?

Answ. *A* 24*l.* 15 $\frac{5}{101}$*s.* and *B* 25*l.* 4 $\frac{96}{101}$*s.*

3. Three Graziers hired a piece of Land for 60*l.* 10*s.* *A* put in 5 Oxen for $4\frac{1}{2}$ Months; *B* put in 8 Oxen for 5 Months; and *C* put in 9 Oxen for $6\frac{1}{2}$ Months: I demand how much each must pay?

Answ. *A* 11*l.* 5*s* *B* 20*l.* and *C* 29*l.* 5*s.*

4. Three Persons have received 665*l.* Interest. A had put in 4000*l.* for 12 Months, B 3000*l* for 15 Months, and C 5000*l.* for 8 Months: how much is each Man's Part of the Interest? *Answ.* A 240*l.* B 225*l.* and C 200*l*

5. Three Persons hired a Piece of Land for *l.* 12 10 6; A put in 20 Sheep for 5 Days, B put in 16 Sheep for 7 Days, and C put in 25 Sheep for 4 Days: I demand how much each must pay?

Answ. A *l.* 4 0 $3\frac{6}{13}$, B 4 9 $11\frac{1}{13}$, and C 4 0 $3\frac{6}{13}$.

6. Three Merchants lost by some dealings 45*l.* 10*s.*; A's Stock was 100*l.* for $6\frac{1}{2}$ Months, B's Stock 100*l.* for $9\frac{1}{2}$ Months, and C's 150*l.* for $8\frac{2}{3}$ Months; what is each Man's Part of this Loss?

Answ. A *l.* 10 $3\frac{28}{29}$*s.* B *l.* 14 $18\frac{2}{29}$*s.* and C 20*l.* $7\frac{27}{29}$*s.*

7. Three Merchants put in a Stock, *viz.* A puts in the 1st of *January* 120*l.* until the 23d of *March*; B puts in 176*l.* the 10th of *February*, until the 12th of April; C puts in 295*l* the 2d of *February*, until the 25th of April; and they gain 800*l.* I want to know each Man's Part of the Gain, allowing 28 Days to the Month of *February*?

Answ. A *l.* 174 3 $4\frac{37200}{44646}$, B *l* 192 7 $6\frac{6180}{44646}$, and C *l.* 433 9 $1\frac{1266}{44646}$.

CHAP. XI.

ALLIGATION.

IS that Rule whereby we reſolve Queſtions concerning the mixing of ſeveral Simples, or Commodities into one compound Quantity.

Alligation is either *Medial* or *Alternate.*

Alligation Medial is, when having the ſeveral Quantities and Rates of divers Simples propoſed, we diſcover the Rate of a mixture compounded of theſe Simples.

Rule.

Find according to the given Rates, the Value of each given quantity, then taking the Sum of theſe Quantities, and the Sum of their Values, ſay, If that Sum of Quantities give that Sum of values what will the Quantity (propoſed) give?

Application.

1. Suppoſe 15 Buſhels of Wheat, at 5*s* the Buſhel, and 12 Buſhels of Rye, at 3*s*. 6*d*. *per* B. were mixed together, what is the mean Rate or Price it may be ſold at a Buſhel, without Loſs or Gain.

	s.	*d.*		*l.*	*s.*
15 Buſhels, at	5	0	come to	3	15
12 ditto, ——	3	6	——	2	2

Conſequently 27 Buſh. their Sum come to 5 17 what is that for 1 Buſhel;

3)		
27	—5	17
9)	1	19

Anſwer, 4*s*. 4*d*.

The Reaſon of this Operation is manifeſt in itſelf.

To prove the Truth of the WORK.

Find the Value of all the Mixture at the mean Rate: Likewiſe the Value of each particular Quantity propoſed to be mixed at its given Rates, and collect theſe particular Values into one Sum, if the ſaid Sum is equal to the Value of all the mixture before found, the Work is right, as

	s.	d.			s.	d.	l.	s.
27 Bushels, at	4	4		15 Bush. at	5	0—	3	15
		3		12 ———	3	6—	2	2
	0 13	0		Total,		*l.*	5	17
		9						
Come to	*l.* 5 17	0						

2. A Tobacconist mixeth 36 lb of Tobacco, worth 1*s.* 6*d.* a Pound, with 12 lb of another Sort, at 2*s.* a Pound; and 12 lb of a third Sort, at 1*s.* 10*d.* *per* Pound. How may he sell the Mixture *per* Pound? *Answ.* 1*s.* 8*d.*

3. A Vintner mixeth $31\frac{1}{2}$ Gallons of *Malaga* Sack, worth 7*s.* 6*d.* the Gallon, with 18 Gallons of Canary, at 6*s.* 9*d.* the Gallon; $13\frac{1}{2}$ Gallons of Sherry, at 5*s.* the Gallon; and 27 Gallons of white Wine, at 4*s.* 3*d.* the Gallon. 'Tis required to find what one Gallon of this Mixture is worth? *Answer*, 6*s.* *per* Gal.

4. A Druggist has 200 lb of Ginger at 6*d.* the lb; 300 lb at 7*d.* the lb; and 400 lb at 8*d.* the lb. Now if he mixes them together, what will 1 lb cost? *Answ.* $7\frac{2}{9}$*d.*

5. 100 Casks of Butter, qt. 200*C.* 3*qrs.* 14*lb.* at 18*s.* 8*d.* *per* C. are mixed with 150 Casks, qt. 306*C.* 1*qr.* 7*lb.* at 28*s.* *per* C; and with 200 Casks, qt. 420*C.* 3*qrs.* at 23*s.* 4*d* *per* C. I demand what 1 C. of said Butter stands him? *Answ* 23*s.* 10 $\frac{110}{363}$*d.*

6. There are melted and mixed together, two Sorts of Silver; one Sort is worth 5*s.* and the other 4*s.* an ounce; and there were 4 Ounces of the first, and 8 Ounces of the latter: what is the Value of one Ounce of this mixture?

Answer, 4*s.* 4*d.*

7. A Goldsmith melts 8*lb.* $5\frac{1}{2}$*oz.* of Gold Bullion of 14 * Caracts fine, with 12*lb.* $8\frac{1}{2}$*oz.* of 18 Caracts fine. I demand how many Caracts fine this mixture is?

Answer, 16 $\frac{51}{127}$ Caracts

8. A Refiner has 10 lb of Gold of 20 Caracts fine, and melts it with 16 lb of 18 Caracts fine. The Question is how much Alloy must be put to it to make 22 Caracts fine?

N 3 *Answer*,

* An Ounce of pure Gold being reduced into 24 equal Parts, these Parts are called Caracts; but Gold is often mixed with some baser Metal, which in the mixture is called the Alloy: and according to the proportion of pure Gold which is in every Ounce, so the mixture's said to be so many Caracts fine: Thus, if only 22 Caracts of pure Gold and two of Alloy, it is 22 Caracts fine: if 20 Caracts of pure Gold and 4 of Alloy it is 20 Caracts fine; if there is no Alloy, it is 24 Caracts fine, or pure Gold.

Answer, 'Tis not fine enough by $3\frac{3}{13}$ Caracts, so no Alloy must be put to it, but more Gold.

Sect. II.

ALLIGATION ALTERNATE.

ALLIGATION *Alternate* is, when we have the several Ingredients to be mixed, and the mean Rate of the Mixture given, to find such Quantities of the Simples or Ingredients, as being mixed together, shall bear that common Rate.

Rule.

The Rates being all of, or reduced to one Denomination. 2. Set the Rates of the Simples in a Column under one another; and the mean Rate on the Left hand of these. 3. Connect or link together the several simple Rates, so that every one less than the Mean be linked to one or more greater than it, and every one greater with one or more less. 4. Take the Difference between the mean Rate and that of the several Simples, and write it over against all the Simples with which that one (whose Difference it is) is linked, then the Sums of these Differences standing against every simple Rate, are such Quantities of the several simples against which they stand as answer the Question.

I. When the simple Rates do not exceed three, there can be but one Way of linking them; because the Mixture or mean Rate must be between the highest and lowest Rate of the simples; else, 'tis plain the Mixture would not bear that Rate, but would be of a greater or lesser Rate, as the Simples were either all of a greater or lesser: So then of two simples one will be greater and one less than the mean Rate and of three one greater and two less, or two greater and one less, which Cases can admit but one Way of linking.

Examples.

1. How much Wheat at 6*s*. the Bushel, and Barley at 3*s*. 8*d*. per Bushel will make a Mixture that may stand in 4*s*. 4*d*. the Bushel?

$$\text{Mean Price } \overset{d.}{52} \left\{ \begin{array}{l} 72 \\ 44 \end{array} \right\} \left. \begin{array}{r} 8 \\ 20 \end{array} \right\} \begin{array}{l} \textit{Ans.}\ 8 \text{ of Wheat at } 6s. \\ 20 \text{ of Barley, at } 3s.\ 8d. \end{array}$$

The

THE PROOF.

Questions in this Rule are proved by *Alligation Medial*, as follows.

```
          s.    l. s.
     8 at 6——2  8
    20 at 3  8—3 13 4
    —        4)————
If 28————————6  1 4————1
             ————————
          7) 1 10 4
             ————————
          l. 0  4 4 Proof.
             ————————
```

2. How much Tobacco of $7\frac{1}{2}d.$ the lb, and $9\frac{3}{4}d.$ the lb must be mix'd so that it will stand in $8\frac{1}{2}d.$ the lb?

Answ. $1\frac{1}{4}$lb. at $7\frac{1}{2}d.$ and 1 lb at $9\frac{3}{4}d.$

3. What Quantity of Sugar at 11*d.* the lb, and $7\frac{1}{4}d.$ the lb, would make a Mixture so that it would stand in $10\frac{1}{4}$ the lb? *Answ.* 3 lb at 11*d.* and $\frac{3}{4}$lb, at $7\frac{1}{4}d.$

4. How many *oz.* of Silver of 11*oz* fine and 8*oz.* fine must be melted together to make the Mass or Mixture 9*oz.* fine. *Answ.* 1*oz.* of 11*oz.* fine, and 2*oz.* of 8*oz.* fine.

II. When one Rate is joined to two others, the Sum of the Differences of the said two and the mean Rate, will be the Quantity sought, at that Rate to which the two are linked.

5. A Merchant hath Sugar of 5*d.* 10*d.* and 12*d.* *per* lb. How much of each Sort must he take that he may sell a Pound for 8*d.*?

```
                          lb
     ⎧ 5  ⎫   | 2,4 | 6 at  5 ⎫
   8 ⎨ 10 ⎬   | 3   | 3 — 10  ⎬
     ⎩ 12 ⎭   | 3   | 3 — 12  ⎭
```

6 How much Rye, at 4*s.* *per* Bushel Barley at 3*s.* *per* Bushel, and Oats at 2*s.* *per* Bushel, will make a Mixture worth 2*s.* 6*d.* *per* Bushel?

Answer, 6 Bushels of Rye, 6 Bushels of Barley, and 24 Bushels of Oats.

7. A Grocer would mix three Sorts of Sugar together, *viz.* one Sort at 10*d.* *per* lb. another at 7*d.* and another at 6*d.* How much of each Sort must he take, that the whole Mixture may be sold for 8*d.* *per* lb.

	lb.		d.
Answ.	3	at	10 *per* lb.
	2	at	7.
	2	at	6.

8. A Vintner has Brandy, at 3, 5, and 6*s.* the Gallon, and has a mind to mix a Quantity of them together, so that it may stand him in 5*s.* 6*d.* the Gallon. I demand how many Gallons he must take of each Sort?

Answ. $\frac{1}{2}$ at 3*s.* $\frac{1}{2}$ at 5*s.* and 3 at 6*s.*

III. If the Number of Simple Rates exceed 3 there may be several Ways of linking them, and every Way brings different Answers; but all giving such Numbers as will answer the thing required.

Examples.

9. A Merchant would mix Wines, at 14, 15, 19 and 22*s.* *per* Dozen, so as the Mixture may be worth 18*s.* What Quantity of each may be taken?

This Sum may be linked 7 different Ways as follow, *viz.*

*i.

18	14	1
	15	4
	19	4
	22	3

or ii.

18	14	4
	15	1
	19	3
	22	4

or iii.

18	14	1,4	5
	15	1	1
	19	4,3	7
	22	4	4

iv.

18	14	4	4
	15	1,4	5
	19	4	4
	22	4,3	7

v.

18	14	1,4	5
	15	4	4
	19	4	4
	22	4,3	7

vi.

18	14	1	1
	15	1,4	5
	19	4,3	7
	22	3	3

vii.

18	14	1,4	5
	15	1,4	5
	19	4,3	7
	22	4,3	7

* Besides the different Answers produced by this different manner of linking the Terms or Simple Prices, Questions in *Alligation Alternate* (being of that kind, Algebraists term unlimited Problems) have an infinite Variety of other Answers; for any other Numbers in Proportion to those found by this Rule (as above) will answer the Question as well as those.

10. A Wine-merchant has 4 Sorts of Wine, *viz.* of 20*d.* 16*d.* 12*d.* and 7*d.* the Quart; how much of each Sort must he take to sell a Quart for 14*d.*?

Answ. 6 Quarts of 7*d.* 2 Quarts at 12*d.* 2 Quarts of 16*d.* and 7 Quarts of 20*d* or otherwise.

11 A Goldsmith has Gold of 17, 18, 22 and 24 Caracts fine; how much must he take of each to make it 21 Caracts fine?

Answ. 3 Caracts of 17, 1 Caract of 18, 3 Caracts of 22, and 4 of 24 fine.

12. A Vintner would make a mixture of Malaga worth 7*s.* 6*d.* *per* Gallon, with Canary at 6*s.* 9*d.* *per* Gallon; Sherry at 5*s.* *per* Gallon, and White Wine at 4*s.* 3*d.* *per* Gallon: What Quantity of each must he take, that the Mixture may be sold for 6*s.* *per* Gallon:

Answ. 12 of Malaga; 18 of Sherry; 21 Canary; 9 White Wine, or otherwise.

SECT. III.

ALLIGATION PARTIAL.

THE particular Rates of the Ingredients proposed to be mixed, the mean Rate of the Whole Mixture, and any one of the Quantities to be mixed being given, to find how much of every one of the other Ingredients is requisite to compose the Mixture.

13. How much Wheat, at 5*s.* the Bushel must be mixed with 12 Bushels of Rye, at 3*s.* 6*d.* *per* Bushel, that the whole Mixture may bear 4*s.* 4*d.* *per* Bushel?

SOLUTION.

First, I find a Quantity of Wheat, which being mixed will bear the Price proposed *viz.* 10 Bushels of Wheat and 8 of Rye: but the given Quantity of Rye being 12 Bushels, I must find a Quantity of Wheat so proportioned to 10 Bushels as 12 to 8 *viz.* 8 : 12 :: 10 : 15. Whence appears the Reason of the

$$52\left\{\begin{matrix}60\\42\end{matrix}\right. \quad \begin{matrix}\overset{b.}{10}\text{ of Wheat.}\\8\text{ of Rye.}\end{matrix}$$

8 —— 12 —— 10

10

8) 120

Answ. 15 Bushels.

or 8 — 10 — 12

Rule.

Set down all the Particulars and find their Differences. Then say, As the Difference standing against the Price of which the Quantity is given, is to the said given Quantity, So is each other Difference, to the Quantity required.

14. How much Alloy must be put to Bullion of $10\frac{4}{5}$ *oz.* fine, to bring it to $7\frac{1}{4}$ *oz.* fine? *Answer*, $5\frac{1}{1}\frac{2}{7}$ *oz.*

15. How much water must be mixt with 63 Gallons of Brandy, at 5*s.* 5*d.* the Gallon, to reduce it to 4*s.* 6*d.* *per* Gallon? *Answ.* $12\frac{5}{8}$ Gal.

16 How much Brass at 14*d.* *per* lb and Pewter of $10\frac{1}{2}$*d.* the lb, must I melt with 50 lb of Copper worth 16*d.* the lb, so that the whole may stand me in 1*s.* the lb?

Answer, 200 at $10\frac{1}{2}$*d.* and 50 at 14*d.*

17. How much Gold of 21 and 23 Caracts fine, must be mixt with 30 *oz.* of 20 Caracts fine, to bring it to 22 Caracts fine? *Answer*, 30 of 21*s.* and 90 of 23.

18. With 60 Gallons of Brandy, at 6*s.* *per* Gallon, I mix Brandy at 5*s.* 4*d.* *per* Gallon, and some water; then I find it stood me in 3*s.* 6*d.* *per* Gallon: I demand how much Brandy, and how much Water I took?

Answ. 60 at 5*s.* 4*d.* and $74\frac{2}{7}$ of water.

19. How much Malaga of 7*s.* 5*d.* the Gallon, and Sherry of 5*s.* 2*d.* the Gallon, and White Wine at 4*s.* 2*d.* the Gallon, must be mixed with 20 Gallons of Canary at 6*s.* 8*d.* the Gallon, so that one Gallon of the Mixture may stand in 6*s.* the Gallon?

Answer, 44 Gallons, at 7*s.* 5*d.*; 16 Gallons, at 5*s.* 2*d.* and 34 Gallons, at 4*s.* 2*d.*

20. How much Alloy, and how much Gold of 21, and 23 Caracts fine, must be put to 30 *oz.* of 20 Caracts fine, to bring it to 18 Caracts fine?

Answer, $16\frac{2}{3}$ *oz.* Alloy, 30 *oz.* of 21, and 30 *oz.* of 23 Caracts fine.

21. How is the above Answer proved to be true?

Sect. IV.

ALLIGATION TOTAL.

THE particular Rates of all the Ingredients proposed to be mixed; and the Sum of all their Quantities, with the mean Rate of that Sum being given; to find the Particular Quantities of the Mixture.

Rule.

Set down all the particular Rates with the mean Rate, as before, and find their differences, and add together all the Differences into one Sum; Then say, As the Sum of all the Differences: is to the Sum of all the Quantities given: So is every particular Difference: to its particular Quantity.

Let it be required to mix Wheat at 5*s.* the Bushel, with Rye, at 3*s.* 6*d.* the Bushel, so as that the whole Quantity may be 27 Bushels, to be sold for 4*s.* 4*d.* a Bushel: What Quantity of each must be taken to make up the Mixture?

$$52\left\{\begin{array}{c|c} 60 & 10 \\ 42 & 8 \end{array}\right.$$

18 —— 27 ⟨ 10, 8   *Answer*, 15 Wheat, —— 12 Barley.

PROOF.

	s.		*l.*	*s.*
15 at	5	comes to	3	15
12 at	3 6	——	2	2
27	——	3)	5	17
		9)	1	19
		0	4	4 *per* Bushel.

22. A Goldsmith hath two sorts of Silver-Bullion, the one of 10*oz.* and the other of 5*oz.* fine, and has a mind to mix a lb. of it, so that it shall be 8*oz* fine; I demand how much of each he must take?

Answ. 4$\frac{4}{5}$ of 5*oz.* fine, and 7$\frac{1}{5}$ of 10 *oz.* fine.

23. A Grocer has Sugar of 12*d* the lb. and of 6½*d.* the lb. and has a mind to mix a Cwt. of it, so that he may sell it at 8*d.* the lb. I demand how much of each sort he must take? *Answ.* 162$\frac{10}{11}$lb. of 6½*d.* and 61$\frac{1}{11}$lb. at 12*d.*

24. A Refiner has Silver of 11½*oz.* and of 7*oz* fine, and has a mind to make a Piece of Work requiring 35lb. of 9¾*oz.* fine: How much must he take of each?

Answ. 21$\frac{7}{18}$lb of 11½*oz.* fine, and 13$\frac{11}{18}$lb. of 7*oz.* fine.

25. Brandy of 3*s.* 6*d* and 5*s* 9*d.* the Gallon is to be mix'd so that a Hhd. of 63 Gallons may be sold for 12*l* 12*s.* I demand how many Gallons must be taken of each?

Answ. 14 Gal. of 5*s.* 9*d* and 49 Gal. of 3*s.* 6*d.*

26. A Vintner has 3 Sorts of Wine, *viz* of 24*d* 22*d.* and 18*d.* the Gallon; now he has a Mind to mix a Cask of

60 Gallons, so that he may sell it at 20*d.* the Gallon; how much must he take of each?

Answer, 12 at 24*d.* 12 at 22*d* and 36 at 18*d.*

27. A Goldsmith has 3 Sorts of Silver, *viz.* of 11, 8, and 5*oz.* fine, and has a mind to make a Piece of Work that shall Weigh 10lb. of 9*oz*, fine; how much of each must he take?

Answer, $5\frac{1}{3}$lb. of 11*oz.* fine, $2\frac{2}{3}$lb. of 8*oz.* fine, and $2\frac{2}{9}$ lb. of 5*oz.* fine.

28. A Cask of 58 Gallons is filled with Liquor of 7, 8, and 10*d.* the Gallon, and then it stands in $9\frac{1}{4}d$ the Gallon; I would know how many Gallons of each Sort was taken?

Answer, $40\frac{6}{10}$ Gal. of 10*d.* and $8\frac{7}{10}$ Gal. of 8*d.* and $8\frac{7}{10}$ of 7*d.*

BOOK IV.

Of EXTRACTIONS, PROGRESSIONS, *&c.*

CHAP. I.

OF THE SQUARE ROOT.

IF a Number to be multiplied into itself any Number of Times, the Product is called a Power of that Number and the Number multiplied in respect to the Product is called its Root, particularly

If a Number be multiplied into itself the Product is a Square Number, *viz.* the Square (or second Power) of the Number multiplied, which Number is likewise the Square Root of the Product.

As $4\times4=16$, So 16 is the Square of 4, and 4 the Square Root of 16.

Having the Root given to find the Square thereof, is only to find the Product of the given Number multiplied by itself, and thus we construct

A TABLE *of the Squares of the single Figures.*

Roots	1	2	3	4	5	6	7	8	9
Squares	1	4	9	16	25	36	49	64	81

This Table being committed to Memory, we are to shew how to extract the Square Root of any Number.

QUESTIONS.

Quest. What is a Square Number?

A. That which is produced from the Multiplication of any Number into itself, which Number is called the Root with respect to its Square.

Q. Repeat the Squares of the single Figures.

A. The Square of 1 is 1, of 2 is 4, *&c.*

Q. How must I extract the Square Root?

A. By the following Rule.

First to prepare the Square, this do,
Point off the Figures two by two:
Beneath the last the Square next less
Put; and its Root i' th' Quotient place:
From the last period take the Square,
Then the next lower Period there
To the Remainder must be brought;
Be this a Dividend: The Quote
Doubled must the Divisor be
To all but Units Place; then see
How oft the greater holds the less,
That Figure must the Quote express,
And the Divisor Units too,
Then as in plain *Division* do.
Thus every Period one by one
We manage and the Work is done.

Q. How is the Work proved?

A. By multiplying the Root into itself, and adding the Remainder, if any.

Examples.

1. What is the Square Root of 256? *Answ.* 16.
2. ——————————— 576?
3. Find the Square Root of 234256?
4. What is the Square Root of 451584?
5. ——————————— 23097636?
6. ——————————— 151321?
7. ——————————— 14122564?
8. ——————————— 2985984?
9. ——————————— 15437041?
10. ——————————— 2990667969?
11. ——————————— 572199960721?

§ 2. *To extract the Square Root of Fractions.*

A Fractional Power may be considered either as an immediate Power, *i. e.* the immediate Product of the Multiplica-

tion of ſome Fraction into itſelf, as $\frac{4}{9}=\frac{2}{3}\times\frac{2}{3}$; or as being only equivalent to ſome immediate Power, as $\frac{8}{18}=\frac{4}{9}$.

12. Find the Square Root of $\frac{27}{75}$? *Anſw.* $\frac{3}{5}$.

13. Find the Square Root of $\frac{36}{100}=\frac{6}{10}$ or $\frac{3}{5}$, &c.

§ 3. *To extract the Square Root of Surd Numbers.*

Such Numbers as have not a perfect Root, or are not perfect Squares, Cubes, &c. are called Surd Numbers.

From which Definition it is manifeſt the Square Root of ſuch Numbers cannot be found exactly; but by Approximation we may come as near the truth as we pleaſe, for which this is the

Rule.

Find the Root of the given Number, as if it was a perfect Square, and when that is done there will be a Remainder, to which prefix two Cyphers (as the next lower Period) and ſo to every ſucceeding Remainder prefix two Cyphers; and proceed at every Step till one more than half the propoſed Number of Decimal Places be obtained (for all the Figures ariſing when the Cyphers are prefixed are Decimals) and then the reſt may be found by plain *Diviſion.*

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† *The* USE *of the* SQUARE-ROOT.

Caſe I.

To find a mean Proportion between any two given Numbers.

Rule.

Multiply the two given Numbers together, and extract the Square Root of the Product, which Roots ſhall be a mean proportional ſought.

Examples.

1. What is the mean proportional between 4 and 9? *Anſ.* 6.
2. What is the mean proportional between 16 and 36? *Anſwer,* 24.

Caſe II.

To find the Side of a Square equal in Area to any given Superficies.

Rule.

Extract the Square Root of the given Superficies, which Root will be the Side of the Square ſought.

Examples.

3. If the Area of a given Circle is 4276,5, I demand the Side of a Square whoſe ſuperficial Content ſhall be equal thereto? *Anſwer*, 65,395.

4. Suppoſe I have an elliptical or irregular Fiſh-Pond, containing in Surface 9 Acres, 2 Roods, 15 Perches, and would have a Square one of the ſame Content; I deſire to know how many Yds. each Side muſt be? *Anſ.* 274,2535*Yd.*

5. If the Content of a given Circle be 160, what is the ſide of a Square equal thereto? *Anſwer*, 12,649.

Caſe III.

Having the Area of a Circle, to find the Diameter.

Rule.

As 355 : 452 : : ſo is the Area to the Square of the Diameter.

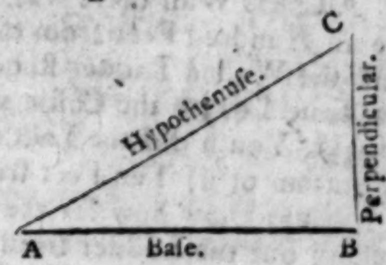
Examples.

6. Required the Diameter of a Circle that will comprehend within its Circumference, the Quantity of an Acre of Land?, *Anſwer*, 99,91 Yards.

7. In the midſt of a Meadow well ſtored with Graſs,
I took juſt two Acres to tether my Aſs;
How long muſt the Cord be, that feeding all Round,
He mayn't graze leſs or more than theſe two Acres of [Ground?
Anſwer, 70,6475 Yards.

Caſe IV.

Any two Sides of a Right-angled Triangle, A, B, C being given, to find the remaining Side.



1. The Baſe and Perpendicular being given to find the Hypothenuſe.

Rule.

Square each Side, add the Squares together, and the Square Root of this Sum gives the Hypothenuſe required.

2. If the Hypothenuſe and one Side be given, to find the other Side.

Rule.

From the Square of the Hypothenuse, subtract the Square of the given Side, the Square Root of the Remainder gives the Side required.

8. A Line 27 Yards long, will exactly reach from the Top of a Fort, on the opposite Bank of a River, known to be 23 Yards broad: the Height of the Wall is required?

Answer, 14,1421 Yards.

9. Suppose a Light House built on the Top of a Rock, the Distance between the Place of Observation and that Part of the Rock level with the Eye, and directly under the Building, is given 310 Fathoms; the Distance from the Top of the Rock to the Place of Observation is 423 Fathoms; and from the Top of the Building 425: the Height of the Edifice is required? *Ans.* 287 8 Fathom Height of the Rock. 2.93156 Do. Height of the Light-House.

10. Two ships set sail from the same Port, one of them sail'd due East 50 Leagues, the other due North 84: How far are they asunder? *Answer*, 97,75 Leagues.

11. The Height of an Elm, growing in the middle of a Circular Island 30 Feet in Diameter, plumbs 53 Feet, and a line stretched from the Top of the Tree straight to the hither Edge of the Water 112 Feet; what then is the Breadth of the Moat, supposing the Land on the other Side the Water to be level? *Answer*, $83\frac{2}{3}$ Feet.

12. Required the length of a shore, that being to strut 11 Feet from the upright of a Building, will support a Jamb 23 Feet 10 Inches from the Ground? *Ans.* 26 Feet, 9 Inches.

13. A Castle Wall there was, whose Height was found
To be an Hundred Feet from th' Top to th' Ground;
Against the Wall a Ladder stood upright,
Of the same Length the Castle was in Height.
A waggish Youth did the Ladder Slide,
(The Bottom of it) Ten Feet from the Side:
Now I would know how far the Top did Fall,
By pulling out the Ladder from the Wall?

Answer, 6 Inches nearly.

Case V.

Any Number of Men being given, to form them into Square Battle, or to find the Number of Ranks and Files.

Rule.

Extract the Square Root of the Number of Men given, will give the Number of Men either in Rank or File.

Example.

14. A General disposing his Army into a Square Battle, finds he has 23716 Men; Required the Number in Rank and File? *Answer*, 154 Men.

THE EFFECTS OF LIGHT AND HEAT.

The Effects or Degrees of Light, Heat, and Attraction, are reciprocally proportional to the Square of their Distance from the Centre whence they are propagated.

1. Suppose that in a Room, where two Men, A, and B. are sitting, there is a Fire, from which A. is three Feet, and B. is six Feet distant; it is required to find how much hotter it is at A's Seat than at B's? *Ans*. A's is 4 times as hot as B's.

2. Supposing the Earth to be 81 Millions of miles distant from the Sun; I would know at what Distance from him another Body must be placed, so as to receive Light and Heat double to that of the Earth? *Answer*, 57275649 Miles.

3. The Distance between the Earth and Sun is accounted 81 Million of Miles, the Distance between Jupiter and the Sun 424 Million of Miles, the Degree of Light and Heat received by Jupiter, compared with that of the Earth is required? *Answer*, The Sun's Influence on the Earth, to that on the Planet Jupiter, is as $27\frac{4}{10}$ to 1.

4. Mercury the nearest of all the Planets to the Sun, is about 32 Millions of Miles from him; Saturn is distant about 777 Millions of Miles; what Proportion is there between the solar Influences on these two Bodies?

Answer, The solar Influence on Mercury to that of Saturn, is as $589\frac{1}{2}$ to 1 nearly.

5. Suppose with Dr. Keil, the Distance of the Sun to be from us 115 of his Diameters; how much hotter is it then at the Surface of the Sun, than under our Equator?

Answer, 13225 Degrees hotter.

The less porous a BODY *is, the greater is it's* DENSITY.

6. The Compactness or Density of the Moon is to that of the Earth, as $132\frac{1}{2}$ is to 100: what Proportion then is there between the Quantity of Matter in the Earth and that in the Moon, since the Earth's Diameter is 7970 Miles, and that of the Moon 2170? *Answer*, The Earth contains 40,117 Times more Matter than the Moon.

VELOCITIES *acquired by heavy* BODIES *falling.*

The Velocity acquired by heavy Bodies falling near the surface of the Earth, is $16\frac{1}{2}$ Feet in the first Second, and as

$16\frac{1}{2}$ Feet are to the Square of one Second, or 1, so is the given Distance to the Square of the Seconds required; or, on the contrary, to determine what Space a heavy Body has passed in any Time given is;

By Multiplying $16\frac{1}{2}$ the Descent of a heavy Body in one Second of Time, by as many of the odd Numbers beginning from Unity, as there are Seconds in the given Time, *viz.* by 1 for the first, 3 for the second, 5 for the third, 7, for the fourth, &c. the Sum total will give the Space it hath passed.

7. Suppose a Stone let fall into an Abyss should be stopped at the End of the eleventh Second after its Delivery, what Space would it have gone through? *Ansr.* 1946,043 Feet.

8. A Ball descending by the Force of Gravity from the Top of a Tower, was observed to fall half the Way in the last second of Time: required the Tower's Height, and the whole Time of Descent?

Answer, $\begin{cases} 187\frac{11}{23} \text{ Feet Tower's Height.} \\ 3\frac{3}{5} \text{ Seconds Time of Descent.} \end{cases}$

9. What is the Difference between the Depth of two Wells, into each of which should a Stone be dropped at the same Instant, one will meet with the Bottom at 6 Seconds, the other at 10? *Answer,* 1029.3 Feet.

10. If a Stone be $19\frac{1}{2}$ Seconds in descending from the Top of a Precipice to the Bottom, what is the Height of the same? *Answ.* 1019 Faths. 1 Ft. $6\frac{3}{4}$ Inches.

11. In what Time would a Musquet ball, dropped from the Top of a Steeple 400 Feet high, be at the Bottom? *Answer,* 5 Seconds nearly.

12. If a Hole could be bored through the Centre of the Earth, in what Time would a heavy Body let fall from its Surface, arrive at its Centre? *Answer,* 18 Min. 55 Sec. 33 Thirds.

Vibrations of Pendulums.

It hath been found by Experiment, that a Pendulum 39.2 Inches long, in our Latitude, vibrates 60 Times in one Minute; and that the Length of the Pendulums are to one another reciprocally, as the Square of the Number of their Vibrations made in the same Space of Time.

1. What Difference is there between the Length of a Pendulum that vibrates Half a Second, or 120 Times in a Minute, and another that Swings double Seconds, or 30 Times in a Minute? *Answer,* 147 Inches.

2. What Difference will there be in the Number of Vibrations made by a Pendulum of 6 Inches long, and another of 12 Inches long, in an Hour's Time?

Answer, 2695.08 the Difference.

3. What Difference is there in the Length of two Pendulums, the One swinging 30 Times, the other 100 Times in an Hour? *Answer*, Diff. 42806.4 Feet.

4. Give the Length of a Pendulum that will Swing once in a Third, once in a Minute, once in an Hour, once in a Day?

Answer, .0108 Inches, the Length of that which vibrates Thirds.

$2\frac{1}{21}$ Miles, the Length of a Pendulum which vibrates once in a Minute.

$8018\frac{2}{11}$ Miles, the Length of a Pendulum which vibrates once in an Hour.

$4618472\frac{8}{71}$ Miles Eng. the Length of a Pendulum which vibrates once in a Day.

CHAP. II.

THE CUBE ROOT.

A Number being multiplied into itself, and the Product again multiplied by the same, produceth a Cube Number, and the Number multiplied is the Cube Root of the Product, as $4\times4\times4$ produceth 64, which 64 is the Cube of 4, and 4 the Cube Root of 64.

Or if a Square Number be multiplied by its Root, the Product is the Cube of that Root, as $16\times4=64$ the Cube of 4.

From either of which Definitions of a Cube, it will be easy to find the Cube of every single Figure, according to the following

TABLE.

Roots	1	2	3	4	5	6	7	8	9
Cubes	1	8	27	64	125	216	343	512	729

Application.

Let it be required to extract the Cube Root of 157464?

	157464 (54	
	125	
7500)	32464	Resolvend.
	30000	
	2400	
	64	
	32464	Subtrahend

(1.) The given Number being pointed over the first and fourth Figures, (2.) the last Period is 157, and the next Cube, is 125, whose Root 5 I put in the Quotient, and the Remainder, after 125 is taken from 157, is 32; to which bringing down the next Period 464. I get the Resolvend 32464 (3.) The Squ. of 5 is 25, which being multiplied by 300 makes 7500 for a Divisor. (4.) Seeking how often this Divisor will go in the Resolvend I find 4 times which I put for the next Quotient Figure, (5) 4×7500=30000; Next the Square of 4 (=16) ×5, the other Figure of the Quotient makes 80, which multiplied by 30 produces 2400, and the Cube of 4 makes 64, which three Numbers being added make the Subtrahend 32464=the Resolvend: So then the given Number is a perfect Cube whose Root is 54.

Again, Let it be required to find the Cube Root of 164566592?

	164566592 (548	
	125	
7500)	39566	1st Resolvend,
	30000	
	2400	
	64	
	32464	Subtrahend,
874800)	7102592	2d Resolv.
	6998400	
	103680	
	512	
	7102592	Subtrahend

The said Number being pointed into Periods of three Figures, and proceeding as before, I get the Resolvend 39566 and its Divisor 7500 which will be contained therein 5 Times; but then there is not a Surplus in the Resolvend equal to the other two Numbers to be brought in, for if I take the Quotient Figure 5 and form a Subtrahend therewith, *per* the Rule, it will result 41475, which is greater than the Resolvend;

solvend; and therefore cannot be subtracted from it as the Rule directs, so I must take a lesser Number as 4, and then I find the Subtrahend 32464 (as before) which I subtract from the Resolvend and there remains 7102, to which I bring down the next Period, and get a new Resolvend 7102592, with which I proceed as with the first, *viz.* I square 54 which makes 2916, this × 300 produces 874800 for a Divisor to said Resolvend in which it is found 8 times; and 8×874800=6998400; the Square of 8, *viz.* 64× 54×30=103680, and the Cube of 8=512; these 3 Numbers added make the Subtrahend 7102592=the Resolvend, and every Period is brought down. So 548 is the Cube Root of the given Number.

QUESTIONS.

Quest. What is a Cube Number?
Answ. A Square Number multiplied by its Root.
Q. What are the Cubes of the single Figures?
A. The Cube of 1 is 1; the Cube of 2, 8; of 3, 27, &c.
Q. How must I extract the Cube Root?
A. First let the Numbers pointed be
In Periods each of Places three;
Beneath the last the Cube next less
Put; and its Root i' th' Quotient place;
The Cube then from the Period take;
Remainder with next Period make
A Resolvend: Then we must see
This Resolvend divided be
By just 300 Times the Square
O'th' Figures which in Quotient are,
Next Quotient Figure such must be
As to allow for Numbers Three;
First for the Product of the said
Figure, by the Divisor made;
That of its Square being multiplied
By all the Quotient beside,
And then by 30 is the second;
And let its Cube the third be reckon'd.
Their Sum must be the Subtrahend,
Not greater than the Resolvend.
Then from the greater take the least;
To the Remainder bring the next
Period: And the same Way descend,
From Point to Point unto the End.

Which done, if ought remain there shall
Add treble Cyphers for a Decimal.

Q. How is the Work proved?

A. Multiply the Root or Quotient into itself, and then the Product by the same Root, adding the Remainder, (if any) to the last Product: so shall we get the given Number if the Work is Right.

Examples.

3. What's the Cube Root of 614125?
4. ———————————— 46656?
5. ———————————— 1463631831?
6. ———————————— 41421736?
7. ———————————— 673373097125?
8. ———————————— 7059199947264?

To extract the Cube Root of a Fraction.

Rule.

Bring the proposed Fraction to its least Terms, and extract the Cube Root of the Numerator for the Numerator, and the Cube Root of the Denominator, for the Denominator of the Root.

Application.

Let it be required to extract the Cube Root of $\frac{64}{216}$?

$$\overset{4)}{\frac{64}{216}} \;\Big|\; \overset{2)}{\frac{16}{54}} \;\Big|\; \frac{8}{27} \;\Big|\; \frac{2}{3} \quad \textit{Answer}, \tfrac{2}{3}.$$

§ 3. *To extract the Cube Root of Surd Numbers.*

Extract the Root of the given Surd Number *per* the Rule before delivered, but when the Work is done there will be a Remainder; to the Remainder prefix three Cyphers, and repeat the Process, and so to every succeeding Remainder, until a Root be got sufficiently near, (for it cannot be found exactly,) and all the Figures arising after the prefixing of Cyphers are a Decimal.

Example.

Example.

Let it be required to extract the Cube Root of 9302348?

9302348 (210 312, &c.
8

1st Divis.——
1200) 1302—first Resolvend

1200=1200 × 1
60=Sq 1 × 2 × 30
1=Cube of 1

1261 Subtrahend

2 Divis. ———
13230000) 41348000—second Resolvend

39690000 = Divisor × 3
56700 = Sq. 3 × 210 × 30
27 = Cube of 3

39746727 - - second Subtrahend

3 Divisor,———
1326782700) 1601273000 - - third Resolvend

1326782700 = Divisor × 1
63090 = Sq. 1 × 2103 × 30
1 = Cube of 1

1326845791 - - third Subtrahend

4th Divisor, ———
132690888300) 274427209000 -fourth Resolvend

265381776600 - - fourth Divisor × 2
2523720 - - Sq. 2 × 21031 × 30, &c.
8

265384300328--fourth Subtrahend

9042908672 Remainder

1st Divisor is 1200= Sq. 2 × 300
2d —— 13230000= Sq. 210 × 300
3d — 1326782700= Sq. 2103 × 300
4th ——————= Sq. 21031 × 300

† THE USE OF THE CUBE-ROOT.

Case I.

To find the Side of a Cube that shall be equal in Solidity to any given Solid, as a Globe, Cylinder, Prism, Cone, &c.

Rule.

Extract the Cube Root of the Solid Content of the given Body, which Root will be the Side of the Cube required.

Examples.

1. There is a Stone of a cubic Form, which contains 21952 solid Feet; what is the superficial Content of one of its Sides; *Answer*, 784 Feet.

Case II.

Having the Dimension of any solid Body, to find the Dimensions of another similar Solid, that shall be any Number of Times greater or less than the Solid given.

Rule.

Multiply the Cube of each Side by the Difference between the solid given and that required, if greater (or divide by the Difference if less) than the solid given; then extract the Cube Root of each Product or Quotient, which will give the Dimensions of the Solid required.

Examples.

2. Suppose the Length of a Ship's Keel to be 125 Feet, the breadth of the Midship Beam 25 Feet, and the Depth of the Hold 15 Feet; I demand the Dimensions of another Ship of the same Form, that will carry three Times the Burthen?

Answ.	Length of the Keel,	180. 28	Feet.
	Breadth of the Beam	36. 05	——
	Depth of the Hold	21. 63	——

3. Again, I demand the Dimensions of another Ship of the same Form, that shall be only half the Burthen of that whose Dimensions are given as above?

Answ.	Length of the Keel,	99. 21	Feet.
	Breadth of the Beam	19 84	——
	Depth of the Hold,	11. 9	——

Case III.

Having the Dimension and Capacity of a Solid, to find the Dimensions of a similar Solid of a different Capacity.

Rule.

Like Solids are in Triplicate Proportion to their Homologous Sides, therefore it will be as the Cube of a Dimension : is to its given Weight : : So is the Cube : of any like Dimension to the Weight sought.

Example.

4. If a Ship of 300 Tuns Burthen be 75 Feet long in the Keel, I demand the Burthen of another Ship, whose Keel is 100 Feet long? *Answ.* 711.111 Tons.

5. Suppose a Ball of 4 Inches Diameter weighs 18lb, I demand the Diameter of another that weighs 114lb?
Answer, 7.4 Inches.

Case IV.

To find two mean Proportionals between two given Numbers.

Rule.

Divide the greater extreme by the less, and the Cube Root of the Quotient, multiplied by the less extreme, gives the lesser mean; multiply the said Cube Root by the lesser Mean, and the Product will be the greater Mean Proportional.

Examples.

6. What are the two mean Proportionals between 7 and 189? *Answer*, 21 and 63.

7. Find two Mean proportionals between 4 and 256?
Answer, 16 and 64.

CHAP. III.

ARITHMETICAL PROGRESSION.

ANY Rank of Numbers encreasing one above another by a common Excess, as 1, 2, 3, 4, 5, &c. which exceed each other by 1; or 2, 4, 6, 8, 10, &c. 1, 3, 5, 7, 9, &c. whose common Excess is 2; or contrariwise decreasing by a common Difference, as 5, 4, 3, 2, 1, 10, 8, 6, 4, 2, are said to be in Arithmetical Progression.

The Numbers which form an Arithmetical Progression are called *Terms of the Progression*, and the Number whereby the latter Term exceeds or is deficient of the former is called the *common Difference*.

As 2, 4, 6, 8, 10, these Numbers are the Terms, and 2 the common Difference.

From the Infinity of Number, it is easy to conceive that an increasing Arithmetical Progression may be infinitely continued; but a decreasing Progression cannot be continued further than till the last Term becomes less than the common Difference.

Numbers in Arithmetical Progression have sundry peculiar Properties, of which are the following.

Proposition 1.

In any increasing Series, If the first Term be added to the Product of the common Difference multiplied by the Number of Terms less 1, the Sum will be the last Term: And in a decreasing Series if the said Product be subtracted from the first Term, the Remainder will be the last Term.

Proposition 2.

If three Numbers are in Arithmetical Progression, the Sum of the two extremes will be double the Mean.

Example.

If 2, 3, 4. $2 + 4 = 6$ and $3 + 3 = 6$
4, 6, 8. $4 + 8 = 12$ and $6 + 6 = 12$
4, 3, 2. $4 + 2 = 6$ &c.

Proposition 3.

If four Numbers be in Arithmetical Progression, the Sum of the Means is equal to the Sum of the Extremes.

Example. $\left\{\begin{matrix} 2, & 4, & 6, & 8 \\ 8, & 6, & 4, & 2 \end{matrix}\right\}$ $2+8=10$ and $4+6=10$

Problem I.

Having two or more Numbers in Arithmetical Progression, none less than the common Difference, to continue the Progression upwards and downwards.

Subtract the less from the greater, and thereby find the common Difference, which add to the greater and subtract from the less, and so will two extreme Terms be found, of which extremes the less being diminished and the greater encreased by the same common Difference, we get two,

other extreme Terms, and thus we may continue the Progression upwards as far as we please, and downwards till we find a Number less than the common Difference, which is the first Term of an encreasing Progression.

Example. Let 8 and 10 be given, and let it be required to continue the Progression both Ways. By deducting 8 from 10 we find the common Difference 2, whence we get this Progression;

0, 2, 4, 6, [8, 10,] 12, 14, 16, 18.

Proposition 4.

In any Arithmetical Progression whose Number of Terms is odd, the mean or middle Term being doubled, is equal to the Sum of any two Terms equally distant therefrom: and if the Number of Terms be even, the Sum of the Means or two middle Terms is equal to the Sum of any two Terms equally distant therefrom.

Example. In 1, 3, 5, 7, 9, 11, 13. $7+7=14$, and $5+9$; $3+11$; $1+13$ each $=14$.

Again, 1, 3, 5, 7, 9, 11, 13, 15. $7+9=16$ and $5+11$; $3+13$; $1+15$ each $=16$.

Cor. Hence if any two Numbers be added, and their Sum halved, that Half is an Arithmetical Mean between the said two Numbers.

In an Arithmetical Progression these five things are more especially to be noted; (1) the first Term; (2) the last Term; (3) the common Difference; (4) the Number of Terms; (5) the Sum of the Series; any three of which being given the rest may be found, which admits of 21 Problems; but the following 3 seeming principally useful in Arithmetick, for Brevity sake we confine ourselves thereto.

Problem II.

Having the first Term, the common Difference and Number of Terms, to find the last Term.

Rule.

Multiply the Number of Terms less 1 by the common Difference, and to that Product add the first Term, the Sum is the last Term required.

Example.

Let 1 be the first Term, 2 the common Difference, and 11 the last Term; $2\times 10\ (=20)+1=21$ last Term.

Cor. If the first Term be = common Difference, then the first Term multiplied by the Number of Terms will produce he last.

O 2

Problem III.

Having the first Term, the last Term, and the Number of Terms, to find the Sum of the Series.

Rule.

Add the first and last Terms together, and multiply half the Sum by the Number of Terms, or the whole Sum by half the Number of Terms, and the Product is the Sum of the Series.

Example.

Let the first Term be 1; the last 21, and Number of Terms 11; Then

$1 + 21 = 22$ whose 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21,
half is $11 \times 11 =$
121 Sum of the Series, or $1 + 19 = 20 \times 5$ (half the Number of Terms) $=$ 100 the Sum of the Series of 10 Terms.

Problem IV.

Having given the first Term, common Difference and Number of Terms, to find the Sum.

Rule.

First find the last Term by *Prob.* 2, and then the Sum by *Prob.* 3.

Examples.

1. How many Strokes doth a regular Clock strike in a natural Day, or 24 Hours? *Answer*, 156.

For at 1 o'Clock it strikes 1, at two, 2, *&c.* so it is required to find the Sum of an Arithmetical Progression 1, 2, 3, *&c* up to 12, where we have 1 the first Term, 1 common Difference; the Number of Terms 12, whence the last Term is found to be 12. So then $1 + 12 = 13 \times 6$ half the Number of Terms produceth 78 the Number of Strokes in the first 12 Hours, which being doubled gives 156 in 24 Hours.

2. A Man buys 17 Yards of Kersey: for the first Yard he gave 2 Shillings; for the last 10*s.* the Price of each Yard encreasing in an Arithmetical Progression; how much did the whole Amount to? *Answer*, 5*l.* 2*s.*

3. How many Strokes doth the Clocks of *Venice* (which go on to be 24 o'Clock) strike in the Compass of a natural Day? *Answer*, 300.

4. The length of my Garden is 94 Feet; now if Eggs be laid along the Pavement 1 Foot asunder, and be fetch'd up singly to a Basket, removed 1 Foot from the last: How much ground must he traverse that does it?

Answer, 1 Mile, 5 Furl. 21 Poles, $3\frac{1}{2}$ Feet *English*.

5. A Merchant hires a Clerk by Covenant for 14 Years, to give him 5*l.* the first Year, and raise his Salary 40*s.* a Year during the Term: The Question is, to discover how much he paid him one Year with another on an average?

Answer, 18*l*.

6. Supposing a Press Gang having a Warrant to press for 30 Days, press the first Day 300 Men, and every succeeding Day 10 more than the former; how many Men will they raise in the 30 Days? *Answer*, 13350.

By these Problems likewise may the Questions relating to Annuities in Arrear be more readily solved: p. 226. For the several Yearly or half-yearly Interests form an Arithmetical Progression, of which the last Interest due may be taken as the first Term and common Difference, and the Number of Years or Half-years, &c. less 1, the Number of Terms, because there is no Interest due upon the last payment, it being only now due.

Example.

If an Annuity of 70*l.* be forborne 5 Years, what will be due at the end of that Term for Principal and Interest thereof, Interest being computed for every Annuity from the Time it became due, at 5 *per Cent. per Annum* Simple Interest?

OPERATION.

	l.	*s.*	
100—5—70	3	10	first Term,
5		4	
$3\vert 50$	14	0	last Term,
20			
	17	10	Sum of first and last,
$10\vert 00$		2	half Number of Terms,
l. 3 10 a Year's Int.	35	0	Amount of Interest,
$70 \times 5 =$	350		Amount of the Annuity.
Answer, *l.*	385	0	

Thus let all the Questions in P. 227 be solved, and likewise the following:

If 70*l.* Annuity, payable by quarterly Payments, were unpaid 5 Years, what will it amount to in that Time, simple Interest being computed at 5 *per Cent.*? *Answ.* *l.*391 11 3.

CHAP. IV.

GEOMETRICAL PROGRESSION.

WHEN a Rank or Series of Numbers do either encrease by one common Multiplier, or decrease by one common Divisor, they are said to be in Geometrical Progression, or Geometrical Proportion continued.

As { 2, 4, 8, 16, 32, 64, here 2 is a com. Multiplier,
64, 32, 16, 8, 4, 2, here 2 is a com: Divisor.
2, 6 18, 54, 162, —— 3 com. Multiplier,
162, 54, 18, 6, 2, —— 3 com. Divisor.

The common Multiplier or Divisor is commonly Termed the Ratio of the Progression.

Proposition 1.

Any three Numbers in Geometrical Progression will form an Analogy, by making the Consequent of the former Ratio the Antecedent of the latter.

As the Numbers 2, 4, 8 will form this Analogy 2 : 4 : : 4 : 8.

Cor. 1. If three Numbers be in Geometrical Progression, the Product of the Extremes multiplied into each other is equal to the Square of the Mean.

Cor. 2. If the Product of two Numbers be equal to the Square of a third, these Numbers are in geometrical Progression.

Problem I.

Having two Numbers to find a mean proportional between them.

Multiply the two Numbers into each other, and extract the Square Root of the Product.

Find a mean Proportional between 4 and 9? *Answ.* 6.

What is the mean Proportional between 4 and 64?
Answer, 16.

Proposition 2.

Any four Numbers in geometrical Progression, will form an Analogy or Proportion.

As 2, 4, 8, 16, 2 : 4 : : 8 : 16, which is manifest.

Cor. Therefore, if four Numbers be in geometrical Progression, the Product of the means will be equal to the Product of the Extremes.

Proposition 3.

In any geometrical Progression the Product of the two Extremes, is equal to the Product of any two Terms equally distant from the two extremes.

3, 6, 12, 24, 48, 96,
3, 6, 12, 24, 48, 96, 192,
As $3\times96=288$ and $6\times48=288$, &c.

If over a geometrical Progression beginning with Unity, we place 1 over the second Term, and so proceed orderly according to the Natural Progression of Numbers, *viz.*

0,	1	2	3	4	5	6	7	8	Indices,
1.	2,	4,	8,	16,	32,	64,	128,	256,	Powers.

The Numbers 1, 2, 3, &c. will express what Power of the Ratio the Term is over which it stands, and are therefore called Indices or Exponents of the Power.

If the first Term given be the Ratio, Then every succeeding Term is the same power of the Ratio as the Order of its Place, or the Index of the Power will denote both the Power and Order of the Place, for 1 must be placed over the first Term, 2 over the second, &c.

1	2	3	4	5	6	7	Indices;
2,	4,	8,	16,	32,	64,	128,	Powers.

Proposition 4.

In any geometrical Progression beginning wirh Unity (if the Indices be supposed placed over the Terms of the Progression) there will be this Coherence or Relation between the Powers and their Indices, *viz.* The Sum of the Indices of any two powers, or Terms of the Progression will be the Index of the Product of the said two Terms, and if the Index of any Term be doubled, its double will be the Index of the Square of said Term in the said Progression.

0	1	2	3	4	5	6	7	8	
1,	2,	4,	8.	16,	32.	64,	128,	256,	Powers,

As $3+5=8$ and $8\times32=256$, Likewise $4+4=8$ and $16\times16=256$, &c.

Proposition 5.

In a Geometrical Progression not proceeding from Unity, if any Term be squared, and the Square be divided by the first or least Term, the Quotient gives a Term of the same Progression doubly distant from the first.

0 1 2 3 4 5 6 7 8
3, 6, 12, 24. 48, 96, 192, 384, 768,

$$\frac{48\times48}{3}=768$$

0 1 2 3 4 5 6 7 8
1, 2, 4, 8, 16, 32, 64, 128, 256

Proposition 6.

In any geometrical Progression not proceeding from Unity, if any two Terms be multiplied together, and the Product divided by the first or least Term, the Quotient will be equal to that Term denoted by the Sum of the Exponents of the other two.

As in the last Progression $\frac{\overset{3}{24}\times\overset{5}{96}}{3}=\overset{8}{768},$

Proposition 7.

In any geometrical Progression, as any one of the Antecedents is to its Consequent, so is the Sum of all the Antecedents to the Sum of all the Consequents.

2, 4, 8, 16, 32, 64, &c.

$2:4::2+4+8+16+32(64)4+8+16+32+64(124)$

Problem II.

To continue a geometrical Progression upwards or downwards.

1. Upwards; Divide any Consequent given by its Antecedent, and the Quotient will be the Ratio, whereby multiply the Consequent and the Product will be the next Term, which being again multiplied by the Ratio, will produce a new Term, and so on, and it is continued downwards by dividing each greater Term by the Ratio.

Problem III.

To find any assigned Term of a geometrical Progression proceeding from Unity without producing all the Terms.

Continue the Progression from Unity to the sixth Term whose Index is 5, Square this sixth Term, and it produces that whose Index is 10, which being likewise squared, its Square will be the Term whose Index is 20; and from those Terms we may easily find all others whose indexes are Decades or even Tens, *viz.* 20+10=30; 20+20=40, and

40+10=50, &c. and from them any other whatever. For the Units are either greater or not greater than 5; if not greater, multiply the Term last found by the Term whose Index denotes the Distance of the assigned Term from that last found; and if greater, multiply first by the Term under 5, and then by the Surplus of the Units or Index of the assigned Term above 5.

Application.

Let it be required to find the 43d Term of a geometrical Progression, beginning with Unity whose Ratio is 2?

0,	1	2	3	4	5	6	7
1,	2,	4,	8,	16,	32,	64,	128

The Progression being continued to the 5th Place 32, whose Index is 5, 32×32=1024, which will be doubly distant from Unity, *viz.* the 11th Term of the Progression whose Index is 10. Again 1024×1024 produces 1048576 the 21st, which being again multiplied by itself, will produce that Term whose Index is 40, *viz.* the 41st; But it is proposed to find the 43d, *viz.* that whose Index is 42, and 40+2=42; wherefore multiply the last found Number which is 1099511627776 by 4, the Number whose Index is 2, and so we get the 43d Term required, 4398046511104.

Problem IV.

To find any assigned Term of a geometrical Progression not beginning with Unity, without producing all the Terms.

Proceed directly as in the last Problem, only observe to divide every Product by the first Term.

Application.

Let it be required to find the 26th Term of a geometrical Progression whose first Term is 2 and Ratio 3?

0	1	2	3	4	5
2,	6,	18,	54,	162,	486

I continue the Progression to the sixth Place, which being squared, and the Product divided by the first Term 2, the Result is 118098 whose Index is 10; this being again squared, and the Product divided by 2, produces 6,973,568,802, whose Index is 20, and this last being multiplied by 486 and divided by 2, produces 1,694,577,218,886, whose Index is 25, which is the 26th Term.

Problem V.

To find the Sum of any geometrical Progression,

If the last or greatest Term be not given, let it be found by *Prob.* 3 or 4, then subtract the least from the greatest; divide the Remainder by the Ratio of the Progression less 1, and to the Quotient add the greatest or last Term.

Application.

Let it be required to find the Sum of the following Progression, 1, 3, 9, 27, 81, 243, 729,

1		From 729 the greatest,
3		Take 1 the least,
9		
27	Ratio 3—1=2)	728
81		
243		364 Quotient.
729		729
1093		1093

QUESTIONS.

1. A Man bought a Horse and was to give a Farthing for the first Nail, 2 for the second, 4 for the third, *&c.* in geometrical Progression: The Number of Nails was to be 7 in each shoe; *viz.* 28 Nails in all: What must be paid for the Horse? *Answer, l.* 279620 5 3¼.

0 1 2 3 4 5
1st,----1, 2, 4, 8, 16, 32 (*per Prob.* 3); the last or 28th Term will be found to be 134217728
Subtract 1

Then Ratio —1=1 which divides not, therefore add 134217727
134217728 the Gr.

4) 268435455

12) 67108863¾

2|0) 559240|5 3

279620 5 3¾

2. A Merchant sold 15 Yards of Sattin; the first for 1*s*, the second for 2*s.* the third for 4*s.* the fourth for 8*s.* I demand the Price of the 15 Yards? *Answ. l.* 1638 7 0.

3. A Draper sold 20 Yards of superfine Cloth; the first Yard for 3*d.* the second for 9*d.* the third for 27*d.* *&c.* in triple Proportion geometrical. I demand the Price of the Cloth? *Answer, l.*21792402 10 0.

4. A Goldsmith sold 1 ℔ of Gold at a Farthing for the first Ounce, a Penny for the second, 4*d.* for the third, &c. in quadruple Proportion geometrical. I demand what he sold the Whole for, also how much he gained by the Sale thereof, supposing he gave for it 4*l.* *per* Ounce?

Answer, { He sold it for *l.* 5825 8 $5\frac{1}{4}$.
And gain'd *l.* 5777 8 $5\frac{1}{4}$.

5. A cunning Servant agreed with a Master (unskill'd in Numbers) to serve him 11 Years, without any other Reward for his Service but the Produce of 1 Wheat-Corn for the first Year; and that Product to be sow'd the second Year, and so on from Year to Year until the End of the Time, allowing the Increase to be but in a tenfold Proportion; that 7680 Wheat-corns make a Pint, and is sold at 3*s.* *per* Bushel? *Answer.* *l.* 33908 8 $4\frac{1}{2}$.

6. A Thresher work'd 20 Days at a Farmer's, and received for the first Day's Work 4 Barley-Corns, for the second 12 Barley-Corns, for the Third 36 Barley-Corns, and so on in triple Proporion geometrical. I demand what the 20 Days Labour came to, supposing the Pint to contain 7680 Corns, and the whole Quantity to be sold at 2*s.* 6*d.* *per* Bushel? *Answ.* *l* 1773 7 6, rejecting Remainders.

7. A Merchant sold 30 Yards of fine Velvet trimmed with Gold very curiously, at 2 Pins for the first Yard, 6 Pins for the second, 18 Pins for the third &c. in triple Proportion geometrical. I demand how much the Velvet produced when the Pins were afterwards sold at an hundred for a Farthing; also, whether the said Merchant gain'd or lost by the Sale thereof, and how much, supposing the said Velvet to have been bought at 50*l.* *per* Yard?

Answer, { The Velvet produced *l.* 2144699292 13 $0\frac{1}{2}$
The Merchant gain'd *l.* 2144697792 13 $0\frac{1}{2}$.

CHAP. V.

COMPOUND INTEREST.

WHAT *Compound Interest* is, is already signified, which see p 212.

From which it follows, that if any Sum, as 100 Pound, be lent out, suppose at 5 *per Cent.* and that the Interest be not paid at the Year's End, there will arise a new Principal of 105*l.* on which Interest must be paid the second Year and if it runs on a third Year, then the Principal for the

third Year will be 105*l.* together with a Year's Interest of 105*l.* *i. e.* 110*l.* 5*s.* &c.

This being well considered, will point out a Method for finding the Amount of any Sum for any Number of Years at Compound Interest. As for

Example.

1. What will 500*l.* amount to in 3 Years, at 8 *per Cent.* Interest upon Interest?

1. If 100 : 108 : : 500 : 540 Amt. of 1st Year.
100 : 108 : : 540 : 583 4*s.*——2d Year,

l. *s.* *l.* *s.* *d.*
100 : 108 : : 583 4 : 629 17 $1\frac{11}{25}$ 3d Year requir.

Or,

1 : 1.08 : : 500 : 540
1 : 1.08 : : 540 : 583.2
: : 583.2 : 629.856.

Which amounts 540, 583.2. 629.856, being produced from 500 by the continual Multiplication thereof by 1.08; the Principal and several Amounts are in a geometrical Progression, (*viz* 500, 540, 583.2, 629.856) whose Ratio is the Amount of 1*l.* for a Year, *viz.* here 1.08, and the Number of Years are continually Indices of the Terms. Likewise,

If the Amount of 1*l.* for any Number of Years be multiplied by any given principal, the Product will be the Amount of that Principal for the same Time.

From which consideration we draw the following

Rule.

Find the Amount of 1*l.* for the given Time (which is to find a Term in the geometrical Progression from 1, whose Index is the Number of Years given) and multiply that Amount of 1*l.* by the Principal given.

Thus the foregoing Exan ple may be done as follows:

0	1	2	3
1,	1.08,	1.1664,	1.259712
			5|00
			l. 629.8560|00
			629 17 $1\frac{1}{2}$

Note, It will be sufficient to keep 5 or 6 Decimal Places complete, how many Terms soever may be required.

2. How much will 320*l.* amount to at 5 *per Cent.* in 10 Years, at Compound Interest?

0	1	2	3
1,	1.05,	1.1025,	1.157625,

52011

1.157625×1.1025 =1.276280=5th Term.

826721

1.628897=10th Term.

320

521.27040

l. 521 4 11$\frac{1}{4}$

At 5 *per Cent.* the continual Multiplier is $1.05 = 1\frac{5}{100} = 1\frac{1}{20}$, wherefore $1 \times 1.05 = 1.05$ second Term, and 1.05 multiplied by 1.05 or $1\frac{1}{20}$=third Term. But this is done when $\frac{1}{20}$ of 1.05 is added to itself, and so continually adding to every new Term $\frac{1}{20}$ of itself produces the next succeeding Term as follows, *viz.*

		Year.
	1	
$\frac{1}{20}$	0.05	
$\frac{1}{20}$	1.05	1
	.0525	
	1.1025	2
$\frac{1}{20}$	.055715	
	1.157625	3
$\frac{1}{20}$	.057881	
	1.215506	4
$\frac{1}{20}$	.060775	
	1.276281	5

But 1.06 (the Amount of 1*l.* at 6 *per Cent.*)$=1.05+.01=1+\frac{1}{20}+\frac{1}{100}$ or $1+\frac{1}{20}+\frac{1}{5}$ of $\frac{1}{20}$. Therefore

1.06——1
$\frac{1}{2}$|6 .053
+$\frac{1}{5}$0.106
————
1.126——2
$\frac{1}{2}$|6 .05618
$\frac{1}{5}$ .011236
————
1.191016---3, &c.

Or, 1.06
1.06
————
636
106
————
1.1236
1.06
————
67416
11236
————
1.191016

By which Methods we may construct Tables of the Amount of 1*l.* at 5 and 6, (or any other Rate) *per Cent.* which being done, the Amount of any Sum for any Time at compound Interest is found by multiplying the tabular Number by the Principal given.

QUESTIONS.

1. What Sum will 450*l* amount to in 3 Years, at 5 *per Cent. per Annum?* *Answer, l.* 520 18 7½.

2. What will 256*l.* 10*s.* amount to in 7 Years, at 6 *per Cent. per Annum*, Compound Interest?
Answer, l. 385 13 7½.

3. What will *l.* 136 15 6 be augmented to, being forborne 20 Years, at 6 *per Cent. per Annum?*
Answer, l. 438 13 1½.

4. What Sum will 500*l.* amount to in 4 Years, at 4½ *per Cent. per Annum*, Compound Interest?
Answer, l. 596 5 2½.

SECT. II.

Of Annuities *or* Pensions *in Arrear, computed at* Compound Interest.

To find the Amount of an Annuity or Pension in Arrear Compound Interest.

Rule.

Find the Amount of the given yearly Sum at Compound Interest, for the given Years less 1, which will be the last Term of a geometrical Progression, of which the given Sum is the first. Then find the Sum of that Progression, and it is the Amount of the Annuity required.

Otherwiſe.

Find the Amount of 1*l.* at Compound Intereſt for the given Years leſs 1. Then find the Sum of that Progreſſion, whoſe firſt Term is 1, and laſt Term the ſaid Amount, and multiply the ſaid Sum by the given Annuity.

Example.

Suppoſe an Annuity of 320*l.* be 10 Years in Arrear, it is required to find what is now due, compound Intereſt being allowed on every Payment, at 5 *per Cent. per Annum*?

Firſt Method,	*By 2d Rule.*
521.247 laſt Term.	1.628897
320.	1.
.05)201.247040	.05)0.628897
4024.9408	12.57794
521.247	1.628897
4546.1878	14.206837
	320
l. 4546 3 8¾	
	28413674
	42620511
	l. 4546.18784

QUESTIONS.

2. An Annuity of 20*l.* *per An.* is forborne 7 Years, what is then due, at 6 *per Cent.* compound Intereſt?

Anſwer, *l.* 167 17 6½.

3. If 30*l.* *per Annum*, yearly Rent be forborne 9 Years, what will it amount to at 6 *per Cent. per Annum* compound Intereſt? *Anſwer,* *l.* 344 14 9¼.

4. Suppoſe a Perſon who had an Annuity of 20*l.* ſuffered it to be in Arrear for 15 Years, what had he then to receive; compound Intereſt being computed at 6 *per Cent. per Ann*?

Anſwer, *l.* 465 10 4½.

Sect III.

Of Rebate *at* Compound Intereſt.

Rule.

Find the Amount of 1*l.* for the given Time at the given Rate, and divide the given Sum to be rebated thereby, the Quotient will be the Sum to be paid down.

Examples.

What ready Money ought to be paid down for a Debt of *l.* 629 17 $1\frac{1}{2}$ due 3 Years hence, Discount at 8 *per Cent. per Annum*, Compound Interest.

1.259712) 629.856000(500*l.* *Answer.*
6298560

2. Suppose *l.* 521 4 $11\frac{1}{4}$ were to fall due 10 Years hence, how much ought to be paid now in full Satisfaction for it, Discount being allowed at 5 *per Cent. per Annum*, Compound Interest? *Answer*, 320*l.*

3. A Legacy of *l.* 520 18 $7\frac{1}{2}$ is left to be paid in 4 Years Time; but the Executor is willing to pay it at the Expiration of 1 Year, upon being allowed Discount at Compound Interest at 5 *per Cent.* which being agreed to, what must he pay? *Answer*, 450*l.*

Sect. IV.

Of the present Worth of Annuities; *and of* Leases *in Reversion.*

Rule.

Find the present Worth of the first and last Year's Annuity, which are the greatest and least Terms of a geometrical Progression: Then find the Sum of that Progression.

1. What is 30*l* yearly Rent to continue 7 Years, worth in ready Money, allowing 6 *per Cent.* Compound Interest, to the Purchaser.

$\frac{30}{1.06}$ = 28.3019 worth of the first Yr's Annu. and Comp. [Term.

$\frac{30}{1.50363}$ = 19.9517 the last and least Term.

.06) 8.3502

139.17
28.3019

167.4719

Answ. *l.* 167 9 5

2. There is an Annuity of 20*l.* *per Annum*, to continue 7 Years to be sold for ready Money; what is it worth,

Compound Intereſt being allowed the Purchaſer at 5 *per Cent.*? *Anſwer*, *l.* 115 14 6½

3. An Annual Rent of 365*l.* paid Yearly, and to continue 12 Years, is to be ſold for ready Money; what is it worth at 5 *per Cent.* Compound Intereſt?

Anſwer, *l.* 3235 1 9.

Now to find the Value of an Annuity or Leaſe in Reverſion, this is the

Rule.

Find the preſent Worth of the Annuity as commencing immediately, and then find what ready Money ought to be paid for that Sum, Rebate at compound Intereſt being allowed for the Term of Years till the Commencement of the Annuity or Leaſe.

Suppoſe it were required to compute the preſent Worth of 75*l.* yearly Rent which is not to commence until 10 Years hence, and then to continue 7 Years after that Time, at 6 *per Cent.* Compound Intereſt.

1. An Annuity of 75*l.* *per Annum*, to continue 7 Years, may be found at 6 *per Cent.* Compound Intereſt to be worth *l.* 418 13 6¾. 2. Then we are to find how much ready Money ought to be paid for this Sum as due 10 Years hence, which will be found *l.* 233 15 9; the Anſwer required.

2. An Annuity of 24*l.* *per Annum*, to begin 7 Years hence, and to continue 21 Years; what is it worth, allowing the Purchaſer 6 *per Cent.* Comp. Intereſt? *Anſ.* *l.* 187 15 5.

But as the finding the Compound Intereſt of any Sum is troubleſome, for a large Term of Years; The following Tables will make the Work of Queſtions relating to Compound Intereſt very eaſy.

TABLE I. *Shewing the Amount of* 1*l.* *for* 31 *Years, at* 5 *and* 6 per Cent. *Compound Intereſt.*			TABLE II. *Shewing the preſent Worth Rebate of* 1l. *for* 31 *Years, at* 5 *and* 6 per Cent. *Comp. Int.*	
Years.	5	6	5	6
1	1.050000	1.060000	.952381	.943396
2	1.102500	1.123600	.907030	.889996
3	1.157625	1.191016	.863838	.839619
4	1.215506	1.262477	.822703	.792093
5	1.276281	1.338225	.783526	.747258
6	1.340096	1.418519	.746215	.704960
7	1.407100	1.503630	.710681	.665057
8	1.477455	1.593848	.676839	.627412
9	1.551328	1.689479	.644609	.591898
10	1.628895	1.790848	.613913	.558394
11	1.710339	1.898298	.584679	.526787
12	1.795856	2.012196	.556837	.496969
13	1.885649	2.132928	.530321	.468839
14	1.979932	2.260904	.505068	.442301
15	2.078928	2.396558	.481017	.417265
16	2.182874	2.540352	.458111	.393647
17	2.292018	2.692773	.436296	.371364
18	2.406619	2.854339	.415520	.350343
19	2.526950	3.025599	.395734	.330513
20	2.653298	3.207135	.376889	.311804
21	2.785962	3.399564	.358942	.294155
22	2.925261	3.603537	.341849	.277505
23	3.071524	3.819750	.325571	.261797
24	3.225100	4.048935	.310067	.246978
25	3.386355	4.291871	.295302	.232999
26	3.555673	4.549383	.281240	.219810
27	3.733456	4.822346	.267848	.207368
28	3.920129	5.111687	.255093	.195630
29	4.116135	5.418388	.242946	.184556
30	4.321942	5.743491	.231377	.174116
31	5.438039	6.088101	.220350	.164255

TABLE

TABLE III.
Shewing the Amount of 1l. *Annuity, forborne for* 31 *Years or under, at* 5 *and* 6 per Cent. *Compound Interest.*

TABLE IV.
Shewing the present Worth of 1l. *Annuity, to continue for* 31 *Years, at* 5 *and* 6 per Cent. *Compound Interest.*

Years	Table III: 5	Table III: 6	Table IV: 5	Table IV: 6
1	1.000000	1.000000	0.952381	0.943396
2	2.050000	2.060000	1.859410	1.833392
3	3.152500	3.183600	2.723248	2.673012
4	4.310125	4.374616	3.545950	3.465105
5	5.525631	5.637093	4.329477	4.212363
6	6.801913	6.975318	5.075692	4.917324
7	8.142008	8.393837	5.786373	5.582381
8	9.549108	9.897467	6.463212	6.209792
9	11.026564	11.491316	7.107821	6.801691
10	12.577892	13.180794	7.721734	7.360086
11	14.206787	14.971643	8.306414	7.886673
12	15.917126	16.869940	8.863251	8.383843
13	17.712982	18.882137	9.393572	8.852682
14	19.598631	21.015065	9.898640	9.294983
15	21.578563	23.275969	10.379658	9.712248
16	23.657491	25.672527	10.837769	10.105894
17	25.840366	28.212879	11.274065	10.477258
18	28.132384	30.905651	11.689586	10.827602
19	30.539003	33.759992	12.085320	11.158115
20	33.065954	36.785590	12.462209	11.469920
21	35.719251	39.992727	12.821152	11.764075
22	38.505214	43.392291	13.163002	12.041580
23	41.430475	46.995826	13.488573	12.303377
24	44.501999	50.815575	13.798641	12.550356
25	47.727099	54.864510	14.093944	12.783354
26	51.113453	59.156381	14.375184	13.003164
27	54.669126	63.705763	14.943033	13.210531
28	58.402583	68.528112	14.898127	13.406162
29	62.322712	73.639799	15.141073	13.590721
30	66.438847	79.058184	15.372450	13.764829
31	70.760790	84.801677	15.592810	13.929084

CONSTRUCTION AND USE OF THESE TABLES.

The first Table may be constructed as shewn p. 308, 309.

The Second may be constructed from the First thus, Let 1 be divided by 4.538039 the last Number of the first, and the Quotient .220359 is the last Number of the second. But the Terms of the second Table are a decreasing Geometrical Progression, whose Ratio is 1.05, 1.06; so contrarywise the Progression beginning at the last Term and continued to the first will be an encreasing Progression, and therefore the last Term being found as above, the rest may be found from it.

31——220359
Add $\frac{1}{2}|_0$ 110179

30——231377
$\frac{1}{2}|_0$ 115688

242946, &c.

Table III. may be constructed from Table I. thus, to 1, the Amt. of Annuity of 1*l.* at the End of 1 Year.

Add 1.05 the Amount of 1*l.* at Compound Interest.
To 2.05 the Amt. of an Annuity of 1*l.* at 2 Years End.
Add 1.1025 the second Term of Table I.

3.1525 the Third Term of Table III.
Add 1.157625 the third of Table I.

4.310125 the fourth Term of Table III. and so proceeding, add to each new Term in Table III. the same Term in Table I. For it is manifest that by this Process we get the Sums of this Progression, 1, 1.05, 1.1025, 1.157625. But these Sums are still the Amounts of an Annuity of 1*l.* It is manifest that Table IV. may be constructed in like Manner from Table II.

The Use.

The Use of these Tables is very easy, being only to multiply any given Sum by the Tabular Number, in the same Row with the given Number of Years.

Example.

Suppose it be required to find the Amount of 136*l.* 15*s.* 6*d.* in 20 Years, at 6 *per Cent. per Annum*, Compound Interest?

£. 136 15 6=136.7525 which multiply by the tabular Number under 6 *per Cent.* and in the same Row with 20, *viz.* 3.207135, and the Product will be *l.* 438.5834, *i. e.* *l.*438 11 8, and so of any other.

Let the sundry Examples of this Chapter be done by the Tables.

CHAP. VI.

OF LOGARITHMS.

LOGARITHMS are Numbers so contrived and adapted to other Numbers that the Sums and Differences of the former correspond to, and shew the Products and

and Quotes of the latter, and alſo their Powers and Roots.

The Logarithms of theſe Numbers in a Decuple Progreſſion from 1, (to which Progreſſion the Logarithms now in Uſe are applied) are called Characteriſticks, becauſe they denote how many Places the correſponding natural Number conſiſts of, which is eaſily apprehended.

Num.	*Logarithms.*
1	0.0000000
10	1.0000000
100	2.0000000
1000	3.0000000
10000	4.0000000
100000	5.0000000

For the Logarithm of 1 is 0. for 1 is not diſtant from itſelf; of 10, 1.0000000 wherefore the Logarithm of every Number between 1 and 10 muſt be a Decimal Fraction: Likewiſe ſince the Logarithm of 10 is .1, and of 100, .2, the Logarithm of every Number between 10 and 100 muſt be greater than 1, and leſs than 2, *i. e.* 1 and a Decimal, and between 100 and 1000 the Log. will be 2 and ſome Decimal; ſo on the contrary, if a Logarithm be a Decimal Fraction the natural Number muſt be between 1 and 10, if it conſiſts of 1 and a Decimal, it is between 10 and 100, if of 2 and a Decimal between 100 and 1000, &c. That is, if the Characteriſtick of a Logarithm be 0, the natural Number is a ſingle Figure; if the Characteriſtick be 1, the natural Number conſiſts of 2 Figures, if 2 of 3, if 3 of 4, &c. 2. The Logarithms of all Numbers in a decuple Proportion differ only in their Characteriſticks, as if the Logarithm of 6.748 be 0.8291751, then, the Logarithm of its Decuples will be as under:

Numbers.	*Logarithms.*
6.748	0.8291751
67.48	1.8291751
674.8	2.8291751
6748	3.8291751
67480	4.8291751

For 6.748×10 produces 67.48, wherefore the Log. of 67.48, *viz.* $0.8291751 + 1$ the Log. of $10 = 1.8291751$, the Log. of 67.48, and ſo of the reſt.

A geometrical Progreſſion may in Fractions be continued downward below Unity, infinitely, in the ſame Proportion as it aſcends in whole Numbers above it, *viz.*

$$\tfrac{1}{1000},\ \tfrac{1}{100},\ \tfrac{1}{10},\ 1,\ 10,\ 100,\ 1000,\ \&c.$$

Or Decimally,

.001, .01, .1, 1, 10, 100, 1000, &c.

And since the Distance of $\frac{1}{10}$ from Unity is equal to the Distance of 10; of $\frac{1}{100}$ = to that of 100 the Log. of $\frac{1}{10}$ will be equal to that of 10; of $\frac{1}{100}$ equal to that of 100, &c. But then since the Logarithm of Unity is 0, the Logarithms of Fractions are negative or descending below 0, for they go on the contrary Way to Whole Numbers, and are there to be marked with the Sign —, as,

$$\begin{array}{ccccccc} -3 & -2 & -1 & 0 & 1 & 2 & 3 \\ \frac{1}{1000}, & \frac{1}{100}, & \frac{1}{10}, & 1, & 10, & 100, & 1000. \end{array}$$

And as Fractions in their Multiplication and Division have contrary Effects to whole Numbers, so have their Logarithms, *viz.* a Fraction multiplying a whole Number diminishes the whole Number and the contrary So a negative Logarithm must be subtracted from a positive Logarithm when Addition is implied, and the contrary; but negative Logarithms are to be added or subtracted amongst themselves, as Addition or Subtraction is implied, as will be easily apprehended from an Example or two of the foregoing Progression, *viz.* $\frac{1}{10}\times 10 = 1 - 1 + 1$. *i. e.* 1 subtracted from 1 = 0 the Log. of 1. $\frac{1}{100}\times 1000 = 10$ and $-2+3$, *i. e.* 2 subtracted from $3=1$. Again, if the Fraction $\frac{1}{10}$ divide 10 the Quotient will be 100. And so Subtraction being implied, add their Logarithms $+1=2$ the Logarithm of 100.

Problems *shewing more particularly the Use of Tables of Logarithms.*

To find the Logarithm of any Number in general.

It is either found by Inspection, being placed to the Right-hand of the Number, or if otherwise placed, suitable Directions are prefixed or annexed to the Tables for the Use of them.

Problem II.

To find the Logarithm of an Integral Number exceeding the Limits of the Table of Logarithms; for Example exceeding 10,000.

Rule.

Take as many Figures to the Left-Hand of the given Numbers as there are in the Table, (*viz.* 4 of them if the Table goes only to 10,000, or 5 if to 100,000) and in the

Place of the Figures not taken, annex o's: Again, to the Number expressed by the Figures taken, add 1, and annex the same Number of o's. Then take the Difference of these two Numbers; also the Difference between the given Number and the first of these, and make this Proportion.

As the Difference of the first two is to the Difference of their Logarithms: So is the Difference of the last: to the Difference of their Logarithms, which added to the Log. of the Number less than the given Number, gives the Logarithm of the Number proposed.

Application.

To find the Logarithm of 123459 from a Table carried only to 10.000.

The two Numbers less and greater than 123459 taken according to the Rule, are 123400 and 123500 whose Logarithms are 5.0913152, and 5.0916670 for the Logarithm of 1234 is 3.0913152, to which add 2 the Logarithm of 100, (because 123400 = 1234 X 10) the Sum 50913152 is the Log. of 123400; also the Logarithm of 1235 is 3.0916670, and so that of 123500 is 5.0916670, and the Proportion is

From	123500	5.0916670	123459
Take	123400	5.0913152	223400

As 100 is to .0003518 so is 59 to .00020756. &c. which added to 5.0913152 the Logarithm of 1234000 the Sum is 50915276, &c. the Logarithm of 123459 nearly.

Problem III.

To find a Number corresponding to any Logarithm which being the Result of an Operation with Logarithms, found in the Table, is not itself found exactly in the Table.

1. If the Characteristick, and first 4 of 5 Decimal Figures, are found in the Table, that's near enough for common Use; and the Number, against that Logarithm in the Table, which is nearest the resulting Logarithm, may be taken as the Number sought. But if greater Exactness is desired, or the Characteristick is beyond the Limits of the Table.

2 Take the two Logarithms, in the Table, whose Decimal Figures are next less, and greater, and also their corresponding Numbers, and make this Proportion:

As the Difference of the greater and lesser Log. is to the Diff. of their corresponding Numbers

So is the Diff. of the given and next lesser Log: to the Diff. of their corresponding Numbers.

Which Difference added to the Number correſponding to that leſſer Logarithm, makes the Number correſponding to the given Logarithm nearly.

Application.

Let the given Logarithm be 4669347 ; the next leſſer and greater are .3010300 the Log. of 2. and .4771213, the Log. of 3 : ſo the Proportion is thus formed.

From	.4771213	3	.4669347
Take	.3010300	2	.3010300
	.1760913 :	1 : :	1659047 : .94215,

which added to 2, makes 2.94215, &c. Number ſought.

Again if it be required to find the Number anſwering to the Logarithm 5.0915121 from a Table not extending beyond 10,000, I ſeek for the higheſt Logarithms in the Table, *viz.* thoſe which have 3 for their Characteriſtick, and the Decimal Figures next leſs and greater, than thoſe of the given Logarithm, and find them to be 3.0913152 the Log. of 1234 and 3.0916670 ; from which we form the following Analogy.

From	5.0916670	Log. of	123500	Given L.	5.0915121
Take	5.0913152	Log. of	123400		5.0913152
	.0003518 :		100 : :		0.0001969 : 56

which added to the leſſer makes 123456.

Now it will be proper to ſhew the Uſe of Logarithms in Calculation, and then conclude.

1. *Of their Uſe in* MULTIPLICATION.

It is manifeſtthat the Sum of the Logarithms of the Factors is the Log. of the Product, wherefore

To multiply one Number by another, add their Logarithms together, and in the Table find the natural Number correſponding to their Sum: That Number is their Product.

Examples.

Multiply	144	Log.	-- 2.1583625	Add
By	12	Log.	-- 1.0791812	
	1728	Log.	-- 3.2375537	

2. Mult. 1385 by 185 — 4. Mult. .1385 by .0185.

3. —— 138.5 by 18.5 — 5. —— 7589 by 6757.

2. *In* DIVISION.

To Divide one Number by another, ſubtract the Logarithm of the Diviſor from the Log. of the Dividend, and the Remainder is the Log. of the Quotient.

Examples.

Divide	1728	Log.	3.2375437	Subtract
By	12	Log.	1.0791812	
Quotient	144	Log.	2.1583625	

2. ——Divide 256225 by 185

3. ———— .0256225 by 1.385

4. ———— 256.225 by 138.5

5. ———— 78956 by 278

3. *In the* Rule of Three *or* Proportion.

Add the Logarithms of the second and third Numbers, and from their Sum subtract the Logarithm of the first.

Example.

If 13 lb of Tea cost 7*l.* 12*s.* what will 66½ lb cost?

13 lb	Log.	1.1139433
: *l.* 7.6	Log.	0.8808136
: : 66.5 lb	Log.	1.8228216
		2.7636352
Answer, : lb 38.8769	Log.	1.5896919

Or this may be done something easier yet, if instead of the Log. of the first Term be taken its Complement Arithmetical, or the Difference of that Logarithm and the Number 10.0000000, which is done by setting down the Difference between each Figure of the Logarithm, and the Figure 9; for then, If the Arithmetical Complement be added with the other two Logarithms, and if Unity, which is the last, be taken away or erased from the Sum, the remaining Figures will be the Logarithm of the fourth Term sought, As,

13 lb Co. Ar.	8.8860567	Add
: *l.* 7.6	0.8808136	
: : 66.5 lb	1.8228216	
	1|1.5896919 as before.	

4. *In* Involution *or raising Powers.*

Multiply the Logarithm of the Root by the Index of the Power, *i. e.* by 2 for the Square; 3 for the Cube, &c.

What is the Square and Cube of 12?

Log. of 12	1.0791812 and	1.0791812
Mult. by	2	3
Log. of 144	2.1583624	3.2375436=Log. 1728

2. What is the Square of 24? *Answer*, 576.
3. What is the Cube of 9? *Answer*, 729.

5. *In* Evolution *or Extracting Roots.*

Divide the Logarithm of the Power by its Index, *i. e.* the Log. of a Square by 2, of a Cube by 3, *&c.* and the Quotient is the Logarithm of the Root.

Examples.

Find the Square Root of 144?

144 Log. 2)2.1583626

1.0791812 Log. of 12.

2. Find the Cube Root of 1728? *An.* 12; (3) of 729? *An.* 9.
4. The Square Root of 160? *Answ.* 12.6491.
5. ———————— .225? *Answ.* .4743.
6. The Cube Root of 123456? *Answ.* 49.7932.

6. *In* Compound Interest, *&c.*

To find the Amount of any Sum for any Time at Compound Intereſt.

Multiply the Logarithm of the Ratio (*i. e.*) the Amount of 1*l.* for 1 Year) by the Number of Years, and to the Product add the Logarithm of the Principal; the Sum will be the Logarithm of the Amount.

Example.

What will 20*l.* amount to, forborne 7 Years, at 6 *per Cent. per Annum*, Compound Intereſt?

Log. of 1.06, the Ratio is —	0.0253059
Multiply by the Time — —	7
	0.1771413
Add Log. of 20 the Prin. —	1.3010299
The Sum is —— ——	1.4781712

Which is the Logarithm of 30.7, or 30*l.* 14*s.* the Amount ſought.

Rule.

From the Logarithm of the Sum to be diſcounted, Subtract the Logarithm of the Rate multiplied by the Time; he Remainder is the Log. of the preſent Worth.

Example.

What present Money will pay a Debt of 20*l.* due 7 Years hence, at 5 *per Cent. per Annum* Compound Interest?

From Log. of 20*l.* — — — — 1.3010300
Subt. Pro. of the Log. Ratio + Time 0.1483251

The Remainder is — 1.1527049

Which is the Logarithm of 14.219 or 14*l.* 4*s.* $4\frac{3}{4}$*d.*

And thus may the other Questions before delivered in *Compound Interest* be resolved.

A COLLECTION OF QUESTIONS TO EXERCISE THE LEARNER IN THE SUNDRY RULES.

A Person dying left his Widow 1780*l.* and 1250*l.* to each of his four Children. 30 Guineas a piece to 15 of his poor Relations, and 150*l.* in Charities; he had been $25\frac{1}{2}$ Years in Trade, and at an Average had cleared 126*l.* a Year. What had he to begin with? *Answ.* *l.*4228 17 6.

2. The Globe of the Earth, under the Line, is 360 Degrees in Circumferrence, each Degree $69\frac{1}{2}$ Miles; and this Body being turned on its own Axis, in 23 Hours, 56 Min. At what Rate an hour are the Inhabitants of *Bencoolen* situate under the Line, carried about from West to East by this Rotation? *Answer*, $1045\frac{1}{3}\frac{4}{5}\frac{1}{9}$ Miles.

3. A Fellow was saying, that when he told over his Basket of Chesnuts 2 by 2, 3 by 3, 4 by 4, 5 by 5, or 6 by 6, there still came an odd one; but when he told them 7 by 7 they came even: How many had he? *Answer*, 721.

4. What Number multiplied by 57 will produce just what 134 multiplied by 71 will do? *Answer*, $166\frac{52}{57}$.

5. There are two Numbers, whose Product is 1610, the greater is given 46; what is the Sum of their Squares, and what the Cube of their Difference?

Answer, Sum of Sq. 3341. The Cube of their Diff. 1331.

6. A, B and C trade in Company; and at making up Accounts, it appears that A and B together gained 13*l.* 10*s.* B and C together 12*l.* 12*s.* And A and C together gained 11*l.* 16*s.* 6*d.* what did they severally gain?

Answer, A *l.*6 7 3. B, *l.*7 2 9. and C, *l.*5 9 3.

7. Some others advance in Trade, as follows, *viz.* W, X and Y raised 350*l.* 10*s.* W, X and Z 344*l.* 10*s.* X, Y and Z made up a Stock of 400*l.* and W, Y and Z contribute 378*l.* 4*s.* In the Conclusion, they parted with their joint Property for 450 Guineas. What did they gain or lose by their Adventure?

Answ. If the Guineas are computed according to the *English* Currency at 21*s.* they lost *l.*18 11 4, but at 22*s.* 9*d.* they gained *l.*20 16 2.

8. There is a Mast or Pole $\frac{1}{9}$ of its Length stands in the Ground, 12 Feet of it in the Water, and $\frac{5}{6}$ of its Length in the Air, or above Water; I demand the whole Length?

Answer, 216 Feet.

9. A and B traded together and gain'd 100*l.* A put in 640*l.* B put in so much that he must receive 60*l.* of the Gain: I demand how much B put in? *Answ.* 960*l.*

10. What Quantity of Water must I add to a Pipe of Mountain-Wine Value 33*l.* to reduce the first Cost to 4*s.* 6*d. per* Gallon? *Answer*, 20$\frac{2}{3}$ Gallons.

11. What Difference is there between the interest of 500*l.* at 5 *per Cent.* for 12 Years, and the Discount of the same Sum, at the same Rate and for the same Time?

Answ. 112*l.* 10*s.* Advantage to the Interest.

12. If 12 Apples are worth 21 Pears and 3 Pears cost $\frac{1}{2}$*d.* what is the Price of fourscore and four Apples? *Ans.* 2*s.* 0$\frac{1}{2}$*d.*

13. Three Merchants, A, B and C have gained 234*l.* which they are to divide so, that when the Profit of A is multiplied by 2, that of B by 3, and C's by 4; their Products are to be equal: I demand how much each of them is to receive? *Answer*, A 108*l.* B 72*l.* C 54*l.*

14. There are 2 Pieces of Linen, the one is 9 Yards shorter than the other, and cost 3*l.* 1$\frac{1}{7}$*s.*; the other Piece at the same Price cost 3*l.* 12*s.* I demand how many Yards were in both Pieces, and the Price of 1 Yard?

Answer, 111 Yards at 1$\frac{1}{7}$*s. per* Yard.

15. A Piece of Satin cost a certain Sum, and being sold for 3*l.* 10*s.* there is lost $\frac{2}{3}$ in a Shilling; I demand the first Cost? *Answer*, *l.*5 16 8.

16. With 13 Gallons of Canary, at 6*s.* 8*d.* the Gallon, I mingled 20 Gallons of White Wine, at 5*s.* a Gallon; and to these add 10 Gallons of Cyder, at 3*s. per* Gallon; at what Rate must I sell a Quart of this Mixture, so as to clear 10 *per Cent.*? *Answer*, 16$\frac{27}{43}$*d.*

17. It is a Rule in some Parishes, to assess the Inhabitants in Proportion to $\frac{8}{13}$ of their Rents: What is the yearly

Rent of that House, which pays 8*l.* 10*s.* to the King under this Limitation, at 5*s* *per l.*? *Answer*, 42*l.* 10*s.*

18. If by selling Hops, at 3*l.* 10*s* *per C.wt.* the Planter clears 30 *per Cent* what was his gain *per Cent.* when the same Goods sold for 4*l.* 5*s.*? *Answer*, *l.*57 17 $1\frac{1}{7}$.

19 If by remitting to *Holland*, at 31*s.* 9*d.* *Flemish per l. Sterling*, 5 *per Cent.* is gained: How goes the Exchange when by Remittance I gain 10 *per Cent.*? *Answ.* 33*s.* $3\frac{1}{7}$*d.*

20. If when Port Wine is 17 Guineas the Hogshead, a Company of 45 People will spend 20*l.* therein in a certain Time; what is Wine a Pipe when 13 Persons more will spend 63*l.* in twice the Time, drinking with equal moderation?

Answer, *l.*43 12 6 nearly, the Guineas being taken as *English*, which is *l.*47 5 $2\frac{1}{2}$ *Irish*.

21. A is dispatched on a Commission from *London* to *Edinburgh*, distant by Computation, say 350 Miles, and his Rout is settled at 22 Miles a Day: 4 Days after B is sent after him with fresh Orders, and is to travel 32 Miles a Day; whereabout on the Road will B overtake A?

Answer, $68\frac{4}{10}$ Miles on this Side *Edinburgh*.

22. If 6lb of Pepper be worth 13lb of Ginger, and 19lb of this be worth $4\frac{3}{4}$lb of Cloves, and 10lb of Cloves be equivalent to 63lb of Sugar, at 5*d* *per* lb what is the Value of 1 C.wt. of Pepper? *Answer*, *l.*7 19 3.

23. If 30 Men can perform a Piece of Work in 11 Days; how many will accomplish another, 4 times as big in one Fifth of the Time? *Answer*, 600.

24. A May-pole 50 Feet, 11 Inches long, at a certain Time of the Day, will cast a shadow 98 Feet, 6 Inches long; I would hereby find the breadth of a River, that running 20 Feet 6 Inches from the Foot of a Steeple, 300 Feet 8 Inches high, the extremity of the Shadow of the Steeple reaches 30 Feet 9 Inches beyond the Stream?

Answer, 530 Feet, 5 Inches nearly.

25. In 81034 Rundlets of Brandy, each 18 Gallons; how many Gross of Bottles, each $\frac{8}{9}$ of a Quart?

Answer, 45581 Gross 7 Dozen and 6.

26. Bought Hose in *London* for 4*s.* 3*d.* *per* Pair, and sold them in *Dublin* for 6*s.* a Pair: Now taking the charges at an Average to be 8*d.* a Pair, and the Exchange is known to be $8\frac{1}{3}$ *per Cent.* Disadvantage; what do I gain *per Cent.* by this Article of Trade? *Answer*, $13\frac{21}{51}$.

27. If the Scavenger's Rate at $1\frac{1}{2}d.$ *per l.* comes to 6*s.* $7\frac{1}{2}d.$ where they ordinarily assess $\frac{4}{5}$ of the Rent: What will the King's Tax for that House be, at 4*s.* in the Pound, rated at the full Rent? *Answer*, 13*l.* 5*s.*

28 A Tradesman increased his Estate annually a Third abating 100*l.* which he usually spent in his Family, and at the End of $3\frac{1}{3}$ Year found that his neat Estate amounted to *l.* 3154 11 8. What had he at outsetting?

Answer, *l.* 1411 12 $9\frac{3}{4}$.

29. A can do a Piece of Work in 10 Days, B alone in 13; set them both about it together, in what Time will it be finished? *Answer*, In $5\frac{15}{23}$ Days.

30. A Cistern is supplid with Water by one Pipe of such bigness, that if the Cock A at the End of the Pipe be set open, the Cistern will be filled in $\frac{1}{2}$ an Hour: But at the Bottom of the Cistern are two other Cocks B and C, whose Capacities are such, that by the Cock B set open alone (all the rest being stopt) the Cistern supposed to be full will be emptied in $1\frac{3}{7}$ Hour: also by the Cock C alone it will be emptied in $2\frac{1}{3}$ Hours: Now because more Water will be infused by the Cock A, than can be expelled by the Cocks B and C in one and the same Time; the Question is, in what Time the Cistern will be filled, if all the said three Cocks be set open at once? *Ans.* $1\frac{9}{71}$ Hour.

31. A Governor of a certain Garrison being desirous to know how much money the Port or Passage of the garrison did amount to, in certain Months, made choice of a loyal Servant, giving him Orders to receive of every Coachman passing with a Coach 4*d.* of every Horseman 2*d.* and of every Footman $\frac{1}{2}d.$ Now at the Year's End the Servant making his Account to the Governor gives him *l.* 94 15 10, and lets him know that as often as 5 passed with Coaches 9 passed on Horseback, and as often as 6 passed on Horseback 10 passed on Foot. The Question is how many Coaches, Horsemen, and Footmen passed?

Ans. 2500 Coaches, 4500 Horsemen, and 7500 Footmen.

32. Twenty Knights, 30 Merchants, 24 Lawyers, and 24 Citizens spent at a Dinner 64 Pounds, which sum was divided among them in such a manner that 4 Knights paid as much as 5 Merchants, 10 Merchants as much as 16 Lawyers, and 8 Lawyers as much as 12 Citizens; The Question is to know the Sum of Money paid by all the Knights; also by the Merchants, Lawyers, and Citizens?

Answ. The 20 Knights paid 20*l* the 30 Merchants 24*l.* the 24 Lawyers 12*l.* and the 24 Citizens 8*l.*

33. There is an Island which is 36 Miles in Compass: Now, if at the same Time, and from the same Place, two Footmen A and B, set forward to travel round about said Island, and follow one another in such a Manner, that A travels every Day 9 Miles, and B 7 Miles; the Question is to find in what space of the Time they will meet again; and also how many Miles and how many Times round the Island each Footman will then have travelled?

Answer, They will meet at the End of 18 Days from their first parting; and then A will have travelled 162 Miles (or $4\frac{1}{2}$ times the Compass of the Island) and B will have travelled 126 Miles (or $3\frac{1}{2}$ Times the Compass of the Island.)

34. A Man dies and leaves a Legacy of 900*l.* to be disposed of among his Relations, *viz.* A, B, C and D; which Legacy is to be disposed of in this Order: B is to have twice as much as A, and C thrice as much as B, and D is to have as much and $\frac{1}{2}$ as C; what must each Person have?

Answ. A's Share is 50*l.* B 100*l* C 300*l.* and D 450*l.*

35. Five Merchants, *viz.* A, B, C, D and E have gained 2025*l.* which they divide in such sort that $\frac{1}{2}$ of the share of A is equal severally to $\frac{1}{4}$ of the share of B, $\frac{1}{5}$ of C, $\frac{1}{6}$ of D, $\frac{1}{8}$ of E: the Question is, what was the share of every Merchant? *Answ* A 162*l.* B 324, C 405, D 486, E 648.

36. Two Merchants A and B are in Company, the Sum of their Stocks is 300*l.*; the Money of A continuing 9 Months, the Money of B 11 Months; they gain 200*l.* which they divide equally, the Question is, how much each Man put in? *Answer*, A 165*l.* B 135*l.*

37. If 3481 Soldiers are to be placed in a Square Battle, how many are to be set in Rank, or in File? *Answ.* 59.

38. If 100*l.* being put forth for Interest at a certain Rate, will at the end of 2 Years be augmented to $112\frac{36}{100}$*l.* (Compound Interest, or Interest upon Interest computed) what Principal and Interest will be due at the first Year's End? *Answer*, 106*l.*

39. If 100*l.* being put forth for Interest at a certain Rate will at the End of 3 Years be augmented to *l.*115.7625 (Compound Interest being computed) what Principal and Interest will be due at the 1st Year's End? *Ansr.* 105*l.*

40. The continual Multiplication of the nine Digits will give the Number of Changes that may be rung on 9 Bells (as well as of any other Combinations) how many are there?

Answer, 362880.

41. There are 2 Numbers; 75 is the leſs, to which the greater is in proportion as 8 to 5, what is the Sum; and the Product of their Sum and Difference; the Difference and Product of their Squares; and the Sum of the Squares of their two Quotes, the greater divided by the leſs, and the leſs again by the greater?

Anſwer, Sum and Sum and Diff. 240, Diff. Sq. 8775, Sum Sq. of the two Quotes $2\frac{1521}{1600}$.

42. In a Series of proportional Numbers the firſt is 5, the third is 8, the Product of the ſecond and third is 78.4, what is the Difference of the ſecond and fourth? *Anſw.* 5.88.

43. If by ſending Pewter to Turkey, and parting with it at $25\frac{2}{3}$*d. per* Pound, the Merchant clear *Cent. per Cent.* what does he clear in *Holland* where he diſpoſes of the *C.wt.* for 8*l.*? *Anſwer*, *l.*2 0 $2\frac{1}{3}$.

44. An Accomptant told a Gentleman who had conſtantly eight Perſons at his Table, that he would gladly make a ninth, and was willing to give 200 Guineas for his Board, ſo long as he could place the ſaid Company at Dinner differently from any one Day before; this being accepted, what did his Entertainment coſt him a Year?

Anſwer, 50*d.* and about $\frac{2}{3}$.

45. It is propoſed by an elderly Perſon in Trade, deſirous of a little Reſpite to admit a ſober and induſtrious young Fellow to a Share in the buſineſs, and to encourage him offers that if his circumſtances will allow him to advance 100*l.* his pay ſhall be 40*l.* a Year; If he ſhall be able to put 200 into the Stock he ſhall have 55*l.* and if 300 he ſhall receive 70*l.* annually: In this propoſal what was allowed for his attendance ſimply? *Anſw.* 25*l.* a Year.

46. A merry young Fellow in a ſmall Time got the better of $\frac{1}{5}$ of his Fortune, by advice of his Friends he then gave 2200*l.* for an Exempt's Place in the Guards, his Profuſion continued till he had no more than 880 Guineas left, which he found by Computation was juſt $\frac{3}{20}$ Part of his Money after the Commiſſion was bought; Pray what was his Fortune at firſt? *Anſwer*, 10450.

47. A has Kerſeys at 4*l.* 5*s.* a-Piece ready Money, in Barter they are charged by him, at 5*l.* 6*s.* each, and $\frac{1}{2}$ of that required down. B has Flax at 3*d. per* Pound, how ought he to Rate it in Truck, not to be hurt by the Extortion of A? *Anſwer*, 5*d.* nearly.

48. Put out 384*l.* to Intereſt, and in $8\frac{1}{4}$ Years there were 542*l.* 8*s.* found to be due, what Rate of Intereſt could then be implied? *Anſw.* 5 *per Cent. per Annum.*

49. M of *Amsterdam* orders N of *London* to remit O of *Paris*, at 54 Pence Sterling *per* Crown, and to draw on P of *Antwerp* for the Value, at $33\frac{1}{2}$*s*. *Flem. per* Pound Sterling but as soon as N received the Commission the Exchange was on *Paris* at $54\frac{1}{2}$ *per* Crown, Pray at what Rate of Exchange ought N to draw on P to execute his Orders and be no Loser? *Answer*, 33*s*. 2 $\frac{34}{109}$*d*.

50. Suppose the Sea allowance for the common Men to be 5 lb of Beef and 3 lb of Biscuit a Day, for a Mess of four People and that the price of the first Barrelled to the King $2\frac{1}{4}$*d*. a lb, and of the second $1\frac{1}{2}$*d*. such as was a Ship's Company that their Flesh cost the Government 12*l*. 12*s*. *per* Day; pray what did it pay for the Bread *per* Week?

Answer, *l*.35 5 $7\frac{2}{10}$.

51. Three Persons enter joint Trade together to which A contributed 210*l*. B 312*l*. they clear 140*l*. whereof 37*l*. 10*s*. belongs of right to C, that Person's Stock and the several gains of the other two are required?

Answ. C's Stock *l*.190 19 6, A gained *l*.41 4 $8\frac{1}{2}$.

52. A Bond was made on the 7th of *August*, 1713, at 6 *per Cent. per Annum* for the Sum of 1114*l*. 10*s*. on the 11th of *May*, 1718, 140*l*. was paid off, and a fresh Bond entered into for the Remainder at $5\frac{1}{4}$ *per Cent. per Annum*, at the Time the Interest of this last was *l*.21 16 8, there was paid off *l*.87 11 9, the old Bond being then taken up, a new one was then given for the Residue, which being paid off on the 11th of *September*, 1724, the Bond Owner took no more than *l*.1409 16 8 in full Payment; at what Rate then did he take Interest *per Cent. per Annum* upon the last Renewal of the Bond? *Answ*. *l*.2 9 $6\frac{1}{2}$.

53. A B and C will trench a Field in 12 Days, B C and D in 14, C D and A will do it in 15, and D A and B in 18, in what Time will it be done by all of them together; and by each of them singly?

Answer, Together in 10.83 Days; by A 47.848, B in 38.969, C in 27.194, D in 111.176 Days.

54. A, B and C company, A put in Share of the Stock for 5 Months, and laid Claim to $\frac{1}{3}$ of the Profit, B put in his for 8 Months, C advanced 400*l*. for 7 Months, and required on the Balance $\frac{2}{3}$ of the gain, the Stock of the other two Adventurers is sought. *Answ*. A 168*l*. B 70*l*.

55. If $120\frac{1}{3}$*l*. is to be distributed among 3 Persons, A B C in such sort, that as often as A takes 5, B shall take

4; and as often as B takes 3, C ſhall take 2; what will be the ſhare of each of them?

Anſwer, A 51 $\frac{4}{7}$*l.* B 41 $\frac{9}{35}$*l.* C 27 $\frac{13}{105}$*l.*

56. Divide 1000 Crowns: give A 129 more than B, and B 178 fewer than C?

Anſwer, A 360, B 231, and C 409.

57. Part 250*l.*: Give A 37 more than B, and let C have 28 fewer? *Anſw.* A 117 $\frac{1}{3}$*l.* B 80 $\frac{1}{3}$*l.* and C 52 $\frac{1}{3}$*l.*

58. A Father divided his Fortune among his Sons: He gave A 7 as often as B 4; to C he gave as often 2 as B 5; The Dividend of C came to 2166 $\frac{3}{8}$*l.* what was the Value of the whole Legacy? *Anſw.* *l.* 17060 4 0 $\frac{3}{4}$.

59. A Stationer Sold Quills at 11*s.* *per* Thouſand, by which he cleared $\frac{3}{8}$ of the Money; but growing ſcarce raiſed them to 13*s.* 6*d.* *per* Thouſand; what might he clear *per Cent.* by the latter Price? *Anſw.* *l* 96 7 3 $\frac{3}{11}$.

60. A Perſon was poſſeſſed of $\frac{3}{5}$ Share of a Copper Mine, and ſold $\frac{3}{4}$ of his Intereſt therein for 1710*l.* What was the Value of the whole Property at the ſame Rate?

Anſwer, 3800*l.*

61. What Sum of Money at 3 $\frac{1}{2}$ *per Cent. per Annum* will clear 38*l.* 10*s.* in a Year and Quarter's Time?

Anſwer, 880*l.*

62. X Y and Z working together, can complete a Staircaſe in 12 Days; Z alone can do it in 24 Days; X in 34: In what Time then can Y get it done himſelf?

Anſwer, 81 $\frac{3}{5}$ Days.

63. Two Merchants enter into Partnerſhip, and each of them put in 12 Pieces of Cloth; but thoſe of A coſt 48*l.* more than thoſe of B: The Cloth being ſold they find they have gained 273 $\frac{3}{5}$*l.* of which B has for his ſhare 122 $\frac{2}{5}$*l.* The Queſtion is, to know at how much a-piece each of their Cloths was valued?

Anſwer, A's at 21*l.* and B's at 17*l.*

64 If when a Hhd. of Wine is ſold for 10*l.* there is loſt 6 *per Cent.* How much is the Gain or Loſs *per Cent.* when 5 Hhds. are ſold for 45*l.* 10*s.*? *Anſr.* 14 $\frac{23}{50}$ *per Cent.* Loſs.

65. A Perſon dying left his Wife with Child, and by his Will ordered that if ſhe went with a Son $\frac{2}{3}$ of the Eſtate ſhould belong to him, and the Remainder to his Mother; and if ſhe had a Daughter, he appointed the Mother $\frac{2}{3}$ and the Daughter $\frac{1}{3}$: But it happened ſhe was delivered of both a Son and a Daughter; by which ſhe loſt in Equity 2000*l.* more than if it had been only a Girl. What would have been her Dowry if ſhe had only a Son? *Anſr.* 1750*l.*

66. In Diſtreſs at Sea they threw out 17 Hhds. of Sugar, worth 34*l* *per* Hhd. the worth of which came up to but the $\frac{4}{7}$ of the Indigo they threw overboard; beſides which, they threw out 13 Iron Guns worth 18*l*. 10*s*. a piece, the Value of all theſe amounted to $\frac{3}{7}$ of $\frac{2}{13}$ of that of the Ship and Lading: What Value came into Port?

Anſwer, *l*.4337 15 $6\frac{2}{3}$.

67. A gay Young Fellow, had 18200*l*. left him by an old Uncle. to whoſe Memory he expended 3 *per Cent*. of his whole Fortune, in a ſumptuous Funeral and Monument; 9 *per Cent*. of the Remainder he made a Preſent of to his Couſins, forgotten by the old Man; with $\frac{2}{7}$ of the Remainder he bought a fine Seat, and with $\frac{1}{8}$ of the Reſidue a Stud of Horſes; He ſquandered 550*l*. in gaming; and after having lived at the Rate of 2000*l*. a Year for 19 Months, and ruined his Health, he died. What was there left for his Siſter who was Heir at Law? *Anſw* 6324*l*. 0*s*. 11*d*.

68. Three Perſons purchaſe a Weſt-India Sloop, toward the Payment whereof A advanced $\frac{3}{8}$, B $\frac{3}{7}$, and C 140*l*. How much paid A and B, and what Part of the Veſſel had C? *Anſw.* A paid $267\frac{3}{11}l$ B $305\frac{5}{11}l$ and C's Part $\frac{11}{56}$.

69. A and B clear by an Adventure to Sea, 50 Guineas; their Stocks were as 13 to 10, and they gained 45 *per Cent*. I demand their reſpective Stocks?

Anſwer, A's *l*.71 8 $8\frac{64}{69}$. B's *l*.54 19 $0\frac{8}{69}$.

70. A and B join Stock, and purchaſe Brandies. A's Stock was *l*.19 19 8 more than that of B. Now by ſelling out their Commodity at 55*s*. *per* Anker, A cleared 74*l*. 11*s*. and B 52*l*. 10*s*. The Quantity of Brandy dealt for is required, and the gain upon the Anker?

Anſwer, 88 Ankers, and *l*.1 8 $10\frac{1}{2}$ *per* Anker gained.

71. In an Article of Trade, A gains 14*s*. 6*d*. and his Adventure was 35*s*. more than B's, whoſe ſhare of the Profit is but 8*s*. 6*d*. What are their reſpective Stocks?

Anſwer, A's *l*.4 4 7. B's *l*.2 9 7.

72. Suppoſe I would Exchange *l*.527 17 6 for Dollars, at 4*s*. 6*d*. *per* Piece, Ducats at 5*s*. 8*d* *per* Piece, and Crowns at 6*s*. 1*d*. *per*; and would have 2 Dollars for 1 Ducat, and 3 Dollars for 2 Crowns: How many of each Sort muſt I have? *Anſw*. 927 Dol. $463\frac{1}{2}$ Duc. 618 Cr.

73. A lets B have a Hhd. of Sugar of 18 C.wt. worth 31*s*. for 42*s*. the C.wt. $\frac{1}{3}$ of which he is to pay in Caſh; B hath Paper coſt 14*s*. *per* Rheam, which he gives A for the reſt of his Sugar, at 15*s*. 6*d*. Who gained moſt by the Bargain? *Anſwer*, A by *l*.7 9 3.

74. A and B in Partnership equally divide the gain; A's Money, which was *l.*84 12 6. lay for 19 Months, and B's for no more than 7: The Adventure of the latter is sought? *Answer*, *l.*229 13 $11\frac{1}{7}$.

75. In 117 times 406 Pieces, worth 3*s.* $8\frac{2}{3}$*d.* a Piece, how many Reas, at 20 for 3*d.* *Answ.* 14145040.

76. Lent 100 Guineas, at 4 *per Cent.* which by the 18th *November* 1756, was raised to as many Moydores, bating Half a Drown. Pray what Day did the Bond bear Date?

Answer, 8*ber* 7, 1749, or rather allowing for the Alteration of Style, 7*ber* 26, 1749.

77. A for a Nine Months Adventure received 20*l.* B for one of 7 Months received 23 Guineas and 1*s.* 9*d.* over; and C for lying out of his Contribution 5 Months had a Title to 32*l.* The Total of their Adventures, multiplied into their respective Times is 640: what were their particular Stocks?

Answer, A's *l.*18 3 6, B's 30 13 $5\frac{1}{2}$, and C's 52 6 $10\frac{2}{4}$.

78. A had 15 Pipes of *Malaga* Wine, which he parted with to B, at $4\frac{1}{3}$ *per Cent.* Profit, who sold them to C for *l.*38 11 6 Advantage; C made them over to D for 500*l.* 16*s.* 8*d.* and cleared thereby $6\frac{1}{2}$ *per Cent.* What did this Wine cost A *per* Gallon? *Answer*, 4*s.* $4\frac{1}{2}$*d.*

79. I have imported 80 Jars of *Lucca* Oil, each containing 1180 solid Inches; What came the Freight to at 4*s.* 6*d.* *per* C.wt. Tare one in 10; Counting $7\frac{1}{2}$ lb of Oil to the Wine Gallon of 231 Cubic Inches? *Answ.* *l.*6 15 5.

80. A B and C, Company, and put in together 3860*l.* A's Money was in 3 Months, B's Money was in 5 Months, and C's was in 7 Months; they gained 234*l.* which was so divided that $\frac{1}{2}$ of A's Gain was equal to $\frac{1}{3}$ of B's, and $\frac{5}{3}$ of B's to $\frac{1}{4}$ of C's? What did each gain and put in?

Answer,	A gained 52*l.*	A put in 1400*l.*
	B —— 78	B —— 1260
	C —— 104	C —— 1200

81. There are 7 Chests of Drawers in each of which there are 18 Drawers, and in each of these are 6 Divisions; in each of which is *l.*16 6 8; how much Money is there in the whole? *Answer*, 12348*l.*

82. If 3 Dozen Pair of Gloves be equal in Value to 2 Pieces of Ribbon, 3 Pieces of Ribbon to 7 Dozen of Points, 6 Dozen of Points to 2 Yards of *Flander's* Lace, and 3 Yards of *Flanders* Lace to 81 Shillings; how many Dozen of Gloves may be bought for 28*s.*? *Answ.* 2 Doz.

83. *A* with Intention to clear 30 Guineas on a Bargain with *B*, rates Hops at 16*d.* the Pound, that stood him in 10*d.* *B* apprized of that, set down Malt which cost him 10*s.* 10*d.* *per* Barrel, at an adequate Price: How much Malt did they contract for? *Answer*, 420 Bushels.

84. *A* and *B* venturing equal Sums of Money, clear by joint Trade 154*l.* By Agreement *A* was to have 8 *per Cent.* because he spent Time in the Execution of the Project, and *B* was only to have 5; The Question is, what was allotted *A* for his Trouble? *Answer*, *l.* 35 10 $9\frac{1}{4}$.

85. *A*, in order to put off to *B* 720 Ells of damaged Holland, worth 5*s.* an Ell, at 6*s.* 8*d.* proposes, in Case he has half the Value in Money, to give *B* a Discount of 10 *per Cent.* The Rest *A* is to take out in Saffron, which *B*, apprized of the whole Management, rates in Justice 30*s.* *per* lb. Pray what was it really worth in Ready Money; and what Quantity of Saffron was he to deliver on the Change? *Answer*, 72 lb. worth 20*s.* *per* lb.

86. Laid out in a Lot of Muslin 480*l.* 11*s.* upon Examination of which, 2 Parts in 7 proved damaged; so that I could make but 5*s.* 6*d.* a Yard of the same, and by so doing I lost 49*l.* 6*s.* by it. At what Rate *per* Ell am I to part with the damaged Muslin to make up the said Loss?

Answer, 12*s.* $3\frac{33}{160}$*d.*

87. A young Hare starts 5 Roods before a Greyhound, and is not perceived by him, till she has been up 34 Seconds; she scuds away at the Rate of 12 Miles an Hour, and the Dog in View makes after her at the Rate of 20: How long will the Course hold, and what Ground will he run, beginning with the outsetting of the Dog?

Answer, $58\frac{1}{32}$ Seconds, $1702\frac{1}{4}$ Feet run.

88. *A* leaves *Exeter* at 10 o'Clock in the Morning for *London*, and goes at the Rate of 2 Miles an Hour without Intermission, *B* sets out of *London* for *Exeter*, at 6 the same Evening and rides 3 Miles an Hour constantly: the Question is whereabouts on the Road will they meet if the Distance of the two Cities be 130 Miles?

Answer, $61\frac{3}{5}$ Miles from *Exeter*.

89. A Reservoir of Water hath 2 Cocks to supply it: by the first it may be filled in 44 Minutes; by the second in just an Hour; and it hath a discharging Cock by which it may, when full, be emptied in half an Hour: Now suppose these three Cocks, by Accident should all of them

be left open, and the Water should charce to come in: What Time would this Cistern be in filling? *Answ.* $2\frac{2}{3}$ Hrs.

90. *A* set out from London for Lincoln, at the very same Time that *B* set out from Lincoln to London, distant 100 Miles: At 8 Hours End they meet on the Road, and it then appeared that *A* had ridden $2\frac{1}{2}$ Miles an Hour more than *B.* At what Rate an Hour did each of them travel?

Answer, *A* $7\frac{1}{2}$ Miles, B 5.

91. Bought 7 Tuns of Wine at 17*l.* *per* Hogshead, which I sell again at 1*s.* *per* Pint, what is the whole gain, and how much *per Cent.*? *Answer,* The whole gain *l.* 229 12, and *l.* 48 4 $8\frac{56}{119}$ *per Cent.*

92. There are 100 Stones which lie 1 Yard one from the other, and there is one employed to gather up the Stones 1 by 1, and bring them to a Basket which standing a Yard from the first Stone: The Question is, how many Miles he will go, before the last Stone is brought into the Basket? *Answ.* 4 Miles, 4 Furl. 2 Perch. 6 Yds. *Irish* Mea.

93. A Minor of 12 Years of Age was left an Estate of 150*l.* *per Annum:* his Guardian was allowed by his Father's Will 40*l.* *per Annum* for his Board, Education, and other contingent Charges, and was to put out the Surplus to Interest for his Benefit, at 5 *per Cent.* Simple Interest: Now supposing no loss of Principal or Interest, what Sum had his Guardian to pay him when he was of Age.

Answer, 1188*l.*

94. A person said he had 20 Children, and that it happened there was a Year and a half between each of their Ages, his eldest was born when he was 24 Years old, and the Age of the youngest is now 21: What was the Father's Age? *Answer,* $73\frac{1}{2}$ Years.

95. One at a Country Fair had a mind to a String of 20 fine Horses, but not caring to take them at 20 Guineas the Head, the Jockey consented that he should, if he thought good, pay but a single Farthing for the first, doubling it only to the 19th, and he would give the 20th into the Bargain: This being accepted, what were they sold for a-Piece? *Answer,* *l* 27 6 $1\frac{47}{80}$ each.

96. What ought a Man to give down in ready Money for the Reversion of 1000*l.* a Year to continue 20 Years, on a Lease, which cannot commence till 5 Years are at an End, allowing the Purchaser Compound Interest at 6 *per Cent.*? *Answer,* *l.* 8570. 19 10.

97. A Minor of 14 had an Annuity left him of 70*l.* a Year, the Proceeds of which, by Will, was to be put

out both Principal and Interest Yearly, as it fell due at 5 *per Cent.* until he should arrive at 21 Years of Age. The utmost Improvement being thus made upon this Part of his Fortune: what had he then to receive? *Ans.* *l.* 569 18 9½

98. Value the Lease of a House in tolerable Repair, the Rent 54*l.* 17*s.* a Year, the Ground-rent 7 Guineas; 3 Years of it only to come; the Rent payable every 6 Mon. Discount *per* Compound Interest on this kind of Purchase, at 10 *per Cent*?

Answer, *l.* 120 10 11½, the Guineas being taken as *English* Currency; but at *l.* 1 2 9 *per*, the *Ans.* is *l.* 118 19 10

99. A Lease for 7 Years is agreed for, at 250*l.* Fine on the old Rent 44*l.* a Year; but the Purchaser being desirous to reduce the Rent to 20*l.* a Year and pay a proper Fine, computing as before, after the Rate of 10*l.* a Year: To what must the Fine be advanced? *Answer*, *l.* 366 16 10.

100. Suppose I would add 5 Years to a running Lease of 15 Years yet to come, the improved Rent being 186*l.* 7*s.* 6*d.* *per Annum*: What ought I to pay down for the Favour, Discount being allowed at 4 *per Cent. per Ann.* Compound Interest? *Answer*, *l.* 460 14 1½.

101. A Person dying left a Piece of Land, let on a 20 Year's Lease for 31*l.* 10*s.* Tax-free; the Profits of this he bequeathed to the Poor of the Parish where he was born, for the first 4 Years after his Decease; the Proceeds of the next 6 Years he left to the Poor of the Parish where he lived; and the Residue or last 10 Years he gave to his Niece; Now this young woman having Money, and being willing to come into the immediate Possession of her Uncle's Land, comes to a Compromise with the Parishes, on a Discount of 10 *per Cent.* What did it Cost her?

Answer, *l.* 193 11 0¾.

AN

AN
APPENDIX OF ALGEBRA.

ALGEBRA (or the great Art) is a Method of managing arithmetical and geometrical Computations by Letters, by means whereof any Queſtion may be clearly ſolved, and curious Theorems deduced for ſolving all Queſtions wherein Numbers or Lines are concerned, which would be in vain to attempt either by Arithmetic or Geometry; the Subject and Deſign of the following Appendix, with my Relation to the Town of *Belfaſt*, as a public Teacher of the Mathematicks, naturally induced me to write this Appendix to Mr. GOUGH's Arithmetick (it being an excellent School-Book) I have here ſubjoined the Principles of Algebra, with ſundry Examples to exerciſe the young Algebraiſt.—Having made every thing ſhort and plain, that the Rules may not be burthenſome to youth.

The Characters or Signs which are uſed in the following Appendix are in the Preceding Book, except the following; x^2 ſignify that x is ſquared x^3=the Cube of x, and x any Power of x, &c.

$\sqrt{}$ = any Square Root. $\sqrt[3]{}$ = the Cube Root, and

$\sqrt[n]{}$ =any Root at Pleaſure.

Quantities that are not known are repreſented by x, y, z and v, thoſe that are known by a, b, c, d, &c.

ADDITION may be comprehended in one Caſe, provided the following Directions be well underſtood.

1. When Quantities are of the ſame Kind, whether they have co-efficients or not, add them together, and their Sum will be the Sum required; but if unlike, ſubtract the co-efficients (if any) and ſet down the Difference with the Sign of the greater, + or — as the Queſtion may require.

Example 1.

$$\begin{array}{r} x+y+z \\ x+y+z \\ x+y+z \\ \hline \text{Sum } 3x+3y+3z \end{array}$$

Example 2.

$$\begin{array}{r} 3x-4y+2z \\ 4x-y+7z \\ 6x-9y+6z \\ \hline \text{Sum } 13x-14y+15z \end{array}$$

N. B. Where no Sign is, the Sign + is underſtood.

Example 3

$$\begin{array}{r} x^2-4xy+5y^2 \\ 6x^2+9xy-7y^2 \\ -2x^2-3xy+8y^2 \\ \hline \text{Sum } 5x^2+2xy+6y^2 \\ \hline \end{array}$$

$$\begin{array}{r} x^2+2xy+y^2 \\ x^2-2xy+y^2 \\ \hline 2x^2 \text{———} 2y^2 \\ \hline \end{array}$$

SUBTRACTION may be performed by changing all the Terms that are to be subtracted—into + or + into—and then adding them together, and the Sum will be the Difference.

Exam. From $6x^2-7y+4z$ $\quad$ $4x^3-3y^2+4z$
Take $3x^2-9y+5z$ $\quad$ $6x^3-9y^2-2z$

$$-3x^2+2y-2z \qquad -2x^3+6y^2+6z$$

Exam. 2

$$\begin{array}{l} ax \\ bx \\ \hline ax-bx \end{array} \qquad \begin{array}{l} ax-by \\ x-z \\ \hline ax-by-x+z \end{array}$$

MULTIPLICATION is performed by one general Rule; observing that like Signs produce + and unlike — in the Product:

N. B. If the Quantities have co-efficients multiply them, if not, join the Letters like the Letters of a Word, observing to place the Sign + or — (as above) before them.

Exam. 1. Multiply x $\quad$ $-x$ $\quad$ x^6
by x $\quad$ y $\quad$ y^8
Product x^2 $\quad$ $-xy$ $\quad$ x^6y^8

$$\begin{array}{l} x+y+z \\ x+y+z \\ \hline x^2+xy+xz \\ \quad\quad xy+y^2+yz \\ \quad\quad\quad\quad xz+yz+z^2 \\ \hline x^2+2xy+y^2+2xz+2yz+z^2 \end{array}$$

$$\begin{array}{l} x^3+y^3+z^3 \\ x^3+y^3+z^3 \\ \hline x^6+x^3y^3+x^3z^3 \\ \quad\quad x^3y^3+y^6+y^3z^3 \\ \quad\quad\quad\quad x^3z^3+y^3z^3+z^6 \\ \hline x^6+2x^3y^3+y^6+2x^3z^3+2y^3z^3+z^6 \end{array}$$

N. B. The Addition of Exponents is the same as Multiplication of Quantities.

$$\begin{array}{l} \text{Multiply } x^6+y^6 \\ \text{by } x^6+y^6 \\ \hline x^{12}+x^6y^6 \\ \quad\quad -x^6y^6-y^{12} \\ \hline x^{12}\text{———}\text{———}y^{12} \end{array} \qquad \begin{array}{l} x^n+v^n \\ x^n-v^n \\ \hline x^{2n}+x^nv^n \\ \quad\quad -x^nv^n-v^{2n} \\ \hline x^{2n}-v^{2n} \end{array}$$

This last shows that the Rectangle or Product of the Sum and Difference of any two Quantities are equal to the Difference of their Squares, which is very useful.

DIVISION—may be performed by one general Rule, being nothing but the Proof of Multiplication; and therefore if the Quantities in the Divisor have like Signs to those in the Divided, the Quotient will be Affirmitive; but if unlike, it will be Negative.

Exam. 1. $x)\,xy+x\,(y+1$

Exam. 2. $xy)\,xy^2\,(y$ *Exam.* 3. $x^2)\,x^5\,(x^3$

Exam. 4. $x+v)\,x^2+2xv+v^2\,(x+v.$

$$x^2+xv$$
$$xv+v^2$$
$$xv+v^2$$

$$x-v)\,x^4-v^4\,(x^3+x^2v+xv^2+v^3$$
$$x^4-x^3v$$
$$\cdot+x^3v-v^4$$
$$x^3v-x^2v^2$$
$$\cdot+x^2v^2-v^4$$
$$x^2v^2-xv^3$$
$$\cdot+xv^3-v^4$$
$$xv^3-v^4$$
$$\cdot\quad\cdot$$

$$x)-xv-xy\,(-v-y$$

$$x-y)\,x^2-2xy+y^2\,(x-y$$
$$x^2-xy$$
$$-xy+y^2$$
$$-xy+y^2$$
$$\cdot\quad\cdot$$

$$x-v)\,x^5-v^5\,(x^4+x^3v+x^2v^2+xv^3+v^4$$
$$x^5-x^4v$$
$$\cdot+x^4v-v^5$$
$$x^4v-x^3v^2$$
$$\cdot+x^3v^2-v^5$$
$$x^3v^2-x^2v^3$$
$$\cdot+x^2v^3-v^5$$
$$x^2v^3-xv^4$$
$$\cdot+xv^4-v^5$$
$$xv^4-v^5$$
$$\cdot\quad\cdot$$

Involution of Quantities is nothing but multiplying them continually together as the Power they are to be raised to—

Thus, $x\times x=x^2\times x=x^3$ &c.

Sir ISAAC NEWTON has given the following Rule for raising any Binominal to any Power, which is this

Rule.

If the Index of the first Letter of any Term be multiplied into its own Co-efficient, and the Product be divided by the Number of Terms to that Place; the Quotient will be the Co-efficient of the next succeeding Term forward.

Required to raise $x+v$ to the 6th Power regularly up.

$\sqrt{\overline{x+v}|^2} = x^2+2xv+v^2 =$ the Square

$\sqrt{\overline{x+v}|^3} = x^3+3x^2v+3xv^2+v^3 =$ the Cube

$\sqrt{\overline{x+v}|^4} = x^4+4x^3v+6x^2v^2+4xv^3+v^4 =$ 4th Power

$\sqrt{\overline{x+v}|^5} = x^5+5x^4v+10x^3v^2+10x^2v^3+5xv^4+v^5 =$ 5th Power.

$\sqrt{\overline{x+v}|^6} = x^6+6x^5v+15x^4v^2+20x^3v^3+10x^2v^4+4xv^5 + v^6 =$ 6th Power and so for as many Powers as you please.

$\sqrt{\overline{x-v}|^2} = x^2-2xv+v^2$

$\sqrt{\overline{x-v}|^3} = x^3-3x^2v+3xv^2-v^3$

$\sqrt{\overline{x-v}|^4} = x^4-4x^3v+6x^2v^2-4xv^3+v^4$

$\sqrt{\overline{x-v}|^5} = x^5-5x^4v+10x^3v^2-10x^2v^3+5xv^4-v^5$.

$\sqrt{\overline{x-v}|^6} = x^6-6x^5v+15x^4v^2-20x^3v^3+10x^2v^4 -4xv^5+v^6$.

Note, All even Terms end with $+$ and them that are odd with $-$

Evolution, or the Extraction of Roots being the reverse of Involutions, or raising of Powers, is performed by converse Operations *(viz.)* by the Division of Indices, as Involution was by their Multiplication ——— Thus the Square Root of $x^6, = x^{\frac{6}{2}} = x^3$ and $x^5 = x^{\frac{5}{2}} = \sqrt[2]{x5}|$ and universally $x^n = x^{\frac{n}{2}} = \sqrt[2]{x^n}|$ ——Required the Square Root of $x-a^2$ it will be $\sqrt{\overline{x-a^2}}|^{\frac{1}{2}}$.

If the Cube Root of any Quantity were to be extracted, put the Radical Sign over the Quantity, with the Index 3 above the Radical, thus; the Cube Root of ax. will be $\sqrt[3]{ax}|$ of $x^{12} = {}^{\frac{12}{3}} = x^4$ and $x^n = x^{\frac{n}{3}}$, &c.

Required the Cube Root of $x^3-3x^2y+3xy^2-y^3$ ∴ $\sqrt[3]{\overline{x^3-3x^2y+3xy^2-y^3}}| = x-y$.

See

See the Work $x^3-3x^2y+3xy^2-y^3\,(x-y$

$$x^3$$

$$3x^2-y)-3x^2y+3xy^2-y^3$$

$$-3x^2y-$$

$$+3xy^2-$$

$$-y^3$$

$$-3x^2y+3xy^2-y^3$$

N. B. As Surd Quantities are not eaſily managed without the help of a Maſter, I thought it beſt to omit them.

Of Equations.

An Equation is when two equal Quantities, differently expreſſed, are compared together, by Means of the Sign $=$ placed between them.

Thus, $9-4=5$ is an equation, expreſſing the Equality of the Quantities $9-4$ and 5.

Alſo $x=n+m$ is an equation ſhewing that x is equal to the Sum of the Quantities n and m.

Equations are the Means whereby we come at ſuch Concluſions as to anſwer the Conditions of any Problem that may be propoſed; and this is called Reduction of Equations.

Reduction of Equations

Has ſundry Rules, according as the Problem is propoſed; therefore when a Problem is propoſed, having but one unknown Quantity, it's called a ſingle Equation, tho' before the Quantity can be cleared we muſt examine it whether it requires Addition, Subtraction, Multiplication, or Diviſion, &c. And then having cleared the unknown Quantity, and brought it to one Side of the Equation, and all the known Quantities to the other, the Problem will be done by ſome of the above Rules.

Here follow a few Examples to illuſtrate the Rule. *Note*, Any Quantity may be tranſpoſed to either ſide of the Equation, by changing its Sign. Thus $x+6=14 \therefore x-14-6=8$—— And if $x-9=3 \therefore x=12$. Let $5x-9=4x+8$. Then it is plain $5x$ muſt be $=4x+17$ and by taking $4x$ out of both Sides of the Equation we have $x=17$.

Reduction where two or more unknown Quantities are concerned; find the Value of any of them, and then compare them together, remembering to get as many Values of each unknown Quantity as you have Equations, otherwiſe it will be in vain to attempt the Solution of any Problem

Problem by any Learner ——Here follow a few Examples that will illustrate the whole,

Let	1	$5x+8y=124$
	2	$3x-2y=20$
$2\times\overline{4}$	3	$12x-8y=80$
1×3	4	$17x=204$
$4\div\overline{17}$	5	$x=\frac{204}{17}=12$
$2\times\overline{5}$	6	$15x-10y=100$
$1\times\overline{3}$	7	$15x+24y=372$
$7-6$	8	$34y=272$
$8\div\overline{34}$	9	$y=8$

Note, When you multiply any Equation by an absolute Number, you must dash the Figure as in Step the 3d, 5th, 7th, &c. to shew that they are not Steps multiplied together

$$\text{Given. } \begin{cases} 5x-3v=90 \\ 2x+5v=160 \end{cases}$$

Now in order to exterminate x, let the first Equation be multiplied by 2, and the second by 5, to make the Co-efficients of x alike, there will arise the two following Equations, $10x-6v=180$

$10x+25v=800$

the first of which subtracted from the second, we have $31v=620$ which Difference being divided by 31 the Co-efficient of v, gives $v=20$, then by transposing $6v$ in the first Equation, we have $10x=180+6v$ or $10x=180+120 \therefore x=30$.

Let	1	$x+y=13=a$
	2	$x+z=14=b$
	3	$y+z=15=d$
$1+3+\overline{3}$	4	$2x+2y+2z=42=a+b+d$
$4\div 2$	5	$x+y+z=21=\frac{a+b+d}{2}$
$5-3$	6	$x=\frac{a+b+d}{2}$ $d=6$
$5-2$	7	$y=\frac{a+b+d}{2}$ $b=7$
$5-1$	8	$x=\frac{a+b+d}{2}$ $a=8$

REDUCTION

Reduction of Equations.

If the Quantities of the Equation be fractional, make them on each Side pure Fractions, then multiply them cross-wise, and the Product may be reduced as before.

Example $\frac{x}{4}=\frac{a}{3}$ then $x\times3=a\times4$ $\therefore$ $3x=4a$. hence $x=\frac{4a}{3}$

Exam. 2. $\frac{x}{4}=\frac{16}{x}$ $\therefore$ $x^2=64$ by extracting the Square Root on both Sides of the Equation, we have $x=8$.

Exam. 3. $\frac{x-b}{a}=\frac{b-x}{n}$, which Equation being multiplied cross-wise, we have, $nx-nb=ab-ax$, and by Transposition and Division we have $x=\frac{ab+nb}{n+a}$

When any Equation has a Radical Sign on one Side, the other Side must be raised to the same Dimension.

Exam. 1. Let $\sqrt{ax}=b$; then by squaring b, we take off the Radical, and we have $ax=b^2$. Now in order to find x we must divide both sides of the Equation by a $\therefore$ $x=\frac{b^2}{a}$, and so for any other.

When a Problem hath two Dimensions, it cannot be answered by any of the Methods before laid down; and therefore we must have recourse to some other Method; which is by compleating the Square, and is performed by the following

Rule.

Add the Square of half the Co-efficient of the unknown Quantity to both sides of the Equation, and the Square will be complete.

Given $x^2+2ax=b$ Required x.

First let a be squared, and added as above; we have $x^2+2ax+a^2=a^2+b$, Then by extracting the Root on both sides of the Equation we have $x+a=\sqrt{a^2+b}$ and by transposing a we have $x=\sqrt{a^2+b}-a$.

Or

Of Problems.

1. Problems are Queſtions to be ſolved.

2 The Solution of a Problem is, the Anſwer to a Queſtion, or the Determination of the Quantity ſought.

3. The Problem has oftentimes various Anſwers, and therefore it's neceſſary to know when it is truly limited; which may be known by the following

Rule.

When the Number of Quantities ſought, exceeds the Number of Equations given, the Queſtion admits of various Anſwers.

Suppoſe $x+y=20$ now it is plain, x may be any Number, whole or broken, being leſs than 20, and y the Remainder.

Rule.

When the Number of Quantities ſought are equal the Number of Equations (not depending on each other) the Queſtion is truly limited.

Axioms for the more ready ſolving of Queſtions.

Ax. 1. If from the Sum of any two Quantities either Quantity be taken, the Remainder is the other Quantity.

Ax. 2. The Difference of any Two Quantities being added to the leſs, the Sum is the greater.

Ax. 3. The Product of any two Quantities being divided by either Quantity, the Quotient is the other.

Ax. 4. The Quotient of any two Quantities being multiplied by the leſs, the Product is the greater

Ax. 5. The Rectangle of the Sum, and Difference of any two Quantities, is equal to the Difference of their Squares.

Ax. 6. The Difference of the Squares of the Sum, and Difference of any two Quantities, is equal four Times their Rectangle.

Ax. 7. The Sum of the Squares of the Sum, and Difference of any two Quantities is equal twice the Sum of their Squares.

$x+y=$ Sum
$x-y=$ Difference
$xy=$ Product
$\frac{x}{y}=$ Quotient
$x^2+y^2=$ Sum of the Squares
$x^2-y^2=$ Difference of the Squares.

Note; The above being underftood, any Problem may be eafily taken in the Algebraic Method.

Solution of Problems.

Prob. 1. The Sum of Two Numbers being 14, and their Difference 4, Required their Nnmbers with a Theorem for all fuch Queftions?

Let $14=a$, $4=b$ and $x=$ lefs then $b+x$ will be the greater Number *per* Ax. 2.

	1	$2x+b=a$ P. Q.
1 — ÷	2	$x=\frac{a-b}{2}=5$
		$b+x=9$

N. B. I fhall follow the above Numbers for 10 Queftions.

Prob. 2. The Sum of two Numbers $=2a$ and their Product. p

Required the Numbers?

$x=\frac{1}{2}$ Difference of the Numbers $a+x=$ greater
$a-x=$ lefs

	1	$a^2-x^2=p$
1 ∓	2	$a^2-p=x^2$
2 √	3	$x=\sqrt{a^2-p}=2 \therefore a+x=9,\ a-x=5$

Prob. 3. The Sum of two Numbers 14 (*a*) and their Quotient 1, 8 (*q*) required the Numbers?

$x=$ lefs & $qx=$ greater Number

	1	$x+qx=a$ P. Q.
1 ÷	2	$x=\frac{a}{q+1}=5$
		$qx=9$

Prob. 4. The Sum of any two Numbers being 14, and the Sum of their Squares 106, required the Numbers?

$14=2a$, $x=\frac{1}{2}$ Difference, $106=b$
$a+x=$ greater & $a-x=$ lefs Number.
1 $2a^2+2x^2=b$
$1 - \div$ 2 $x^2=\frac{b-2a^2}{2}$
$2\ \sqrt{\ }$ 3 $x=\sqrt{\frac{b-2a^2}{2}}=2$
$a+x=9$
$a-x=5$

Prob. 5. The Sum of two Numbers 14, and the Difference of their Squares 56, required the Numbers?

$x=\frac{1}{2}$ Differ. of the Numbers, $14=2a$, $56=b$
$a+x=$ greater $a-x=$ lefs
1 $4ax=b$
$1 \div 4a$ 2 $x=\frac{b}{4a}=2$
$a+x=9$; $a-x=5$

Prob. 6. The Difference of two Numbers 4, and their Product 45, required the Numbers?

$x=\frac{1}{2}$ Sum $4=2a$, $45=b$
$a+x=$ greater, $a-x=$ lefs
1 $a^2-x^2=b$
$1+\sqrt{\ }$ 2 $x=\sqrt{a^2-b}=2$
$x+a=9$
$x-a=5$

Prob. 7. The Difference of two Numbers being 4, and their Quotient 1, 8 required the Numbers?

$x=$ lefs, $1,8=q$, $4=b$
$qx=$ greater
1 $qx-x=b$
$1 \div$ 2 $x=\frac{b}{q-1}=5$
$qx=9$

Prob. 8. The Difference of two Numbers 4, and the Sum of their Squares 106 required the Numbers?

$x = \frac{1}{2}$ Sum $4 = 2a$. $106 = b$

$x + a =$ greater $x - a =$ leſs.

1 | $2x^2 + 2a^2 = b$

1 —÷√ | 2 | $x = \sqrt{\frac{b - 2a^2}{2}} = 2$

$x + a = 9$; $x - a = 5$

Prob. 9. The Sum of two Numbers 14. and the difference of their Squares 56, required the Numbers?

$14 = 2a$, $56 = b$. $x = \frac{1}{2}$ Difference.

$a + x =$ greater $a - x =$ leſs.

1 | $4ax = b$

1 ÷ | 2 | $x = \frac{b}{4a} = 2$

$a + x = 9$

$a - x = 5$

Prob. 10. The Product of two Numbers being 45, and their Quotient 1, 8 required the Numbers?

$45 = b$, 1, $8 = q$

$x =$ leſs, $qx =$ greater.

1 | $qx^2 = b$

1 ÷√ | 2 | $x = \sqrt{\frac{b}{q}} = 5$

$qx = 9$

Prob. 11. What 2 Numbers are thoſe whoſe Sum is 40, and Product only 4, with a theorem for all ſuch Queſtions?

Let $40 = 2a$, $4 = b$, $x = \frac{1}{2}$ Diff. of the Numbers.

then $a + x =$ greater and $a - x$ leſs Number.

1 | $a^2 - x^2 = b$

1 + — | 2 | $a^2 - b = x^2$

2 √ — | 3 | $x = \sqrt{a^2 - b} = 19{,}899$

$a + x = 39{,}899$

$a - x = 0{,}101$

Prob. 12. Required two Numbers whoſe Product is 12, and the difference of their Squares 7?

		$\sqrt{x} =$ greater. $\frac{12}{\sqrt{x}} =$ less
	1	$x - \frac{144}{x} = 7$
$1 \times x$	2	$x^2 - 144 = 7x$
$2 - +$	3	$x^2 - 7x = 144$
$3\ \square$	4	$x^2 - 7x + 12{,}25 = 156{,}25$
$4 \sqrt{-}$	5	$x - 3{,}5 = 12{,}5$
$5 +$	6	$x = 16$
$6 \sqrt{-}$	7	$\sqrt{x} = 4$
	8	$\frac{12}{\sqrt{x}} = 3$

Prob. 13. A Gentleman being aſked how many Guineas he had in his Pocket? anſwered, if the Number I have be multiplied by 4, and the Square Root of the Product be added to the Number of Guineas I have in my Pocket, that Sum will be equal 440, required the Number?

		$x^2 =$ the Guineas he then had.
	1	$x^2 + 2x = 440$ *P. Q.*
$1\ \square$	2	$x^2 + 2x + 1 = 441$
$2 \sqrt{-}$	3	$x + 1 = 21$
$3 -$	4	$x = 20 \therefore x^2 = 400$

Prob. 14. What Number is that which being divided into 4 or 5 equal parts, the Product of all the parts in both Caſes ſhall be exactly the ſame?

		$x =$ the Number
	1	$\frac{x}{4} \times \frac{x}{4} \times \frac{x}{4} \times \frac{x}{4} = \frac{x}{5} \times \frac{x}{5} \times \frac{x}{5} \times \frac{x}{5} \times \frac{x}{5}$ *P. Q.*
$1 \times$	2	$\frac{x^5}{3125} = \frac{x^4}{256}$
$2 \div$	3	$x = \frac{3125}{256} = 12\frac{53}{256}$

Prob. 15. A Merchant ſhips Goods for Jamaica to the Amount of £. 500; pays for Inſurance 5 *per Cent.* for prompt Payment 3 *per Cent.* how much Money ought the Merchant to inſure, ſuppoſing the Goods to be loſt, that he ſhall be no Loſer?

	1	$x=$ the Sum to be insured. $x-\frac{8x}{100}-5=00$
1 $\times$	2	$100x-8x=50000$
2 $\div$	3	$x=\frac{50000}{92}=543\text{-}9\text{-}6\frac{3}{4}$, £. $_2\frac{3}{3}$

Prob. 16. You that are skill'd in mathematic Arts,
Divide 100 into two such Parts,
That when those Parts each other hath divided,
Their Quotients make just 5, if right decided?

		$x=\frac{1}{2}$ Diff. of the Numbers, $100=2a$; $b=5$.
		$a+x=$ greater & $a-x=$ less Number.
		$\frac{a+x}{a-x}+\frac{a-x}{a+x}=b$ P. Q. which reduced.
Gives.	2	$x=\sqrt{\frac{ba^2-2a^2}{b+2}}=32{,}7326$ hence.
		82, 7326 & 17, 2674 are the Parts.

Prob. 17. x Shews the Years; and y the Months explain,
Hence by a Quadratic, you my age may gain.

	1	$x^2y+xy^2=8580=a$ } Reqd. x and y
	2	$x^2y^3+x^3y^2=1338480=b$ }
$2\div1$	3	$xy=\frac{b}{a}=156=n$
$3\div$	4	$y=\frac{n}{x}$
$4+^2$	5	$y^2=\frac{n^2}{x^2}$
∴	6	$nx+\frac{n^2}{x}=a$, by Substitution.
$6\times-$	7	$nx^2-ax=n^2$
$7\div$	8	$x^2-\frac{ax}{n}=-n$ let $-2mx=-\frac{ax}{n}$
then	9	$x^2-2mx-m^2=m^2-n$
$9\surd$	10	$x-m=\sqrt{m^2-n}$
$10+$	11	$x=m+\sqrt{m^2-n}=52$ Years
P 4	12	$y=\frac{n}{x}=8$ Months answering to August.

F I N I S.